SELECTED WATER RESOURCES ABSTRACTS

VOLUME 2, NUMBER 12
JUNE 15, 1969

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A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

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As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.
- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

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ABSTRACT SOURCES

SELECTED WATER RESOURCES ABSTRACTS

02. WATER CYCLE

2A. General

CAN WE CONTROL THE ARCTIC CLIMATE,
For primary bibliographic entry see Field 04A.
W69-04790

A SCALE MODEL STUDY OF SILTING IN THE VILAINE RIVER DUE TO THE ARZAL DAM (FRENCH),
French Central Hydraulic Lab, France.
C. Orgeron.
La Houille Blanche (Rev of French Hydrotech Soc), No 7, pp 621-630, 1968. 10 p, 6 fig, 2 photo, 2 tab.

Descriptors: *Model studies, *Sediment discharge, *Silts, *Physical properties, Dam construction, Hydraulic properties, Salinity, Estuaries, Estuarine environment, Precipitation, Discharge, Mud, Land management.
Identifiers: Vilaine river, Northwestern France.

The hydraulic and chemical environments and the industrial possibilities of the Vilaine river estuary were investigated by using two experimental models of 1:750 and 1:150 scales. The first model represented the estuary and its marine vicinity, and the second one represented the course of the Vilaine river. On the basis of data obtained from these experimental models and using the gage-station hydrologic data of several years, the author summarizes the results of the study of follows: 1. at present the river is in the conditions of quasi-equilibrium dynamics; 2. the alternating up-and-down river transport during the dry and rainy seasons is mainly responsible for the deposition of mud in the estuary; 3. the magnitudes of river discharge greatly modify the conditions of flocculation, salinity and mud deposition; 4. the construction of a dam would not accelerate the process of mud deposition; and 5. careful use of simple methods may be of value in maintaining, and even improving navigational conditions in the estuary. (Gabriel-USGS)
W69-04795

A LOW INTENSITY RAIN SIMULATOR FOR LONG DURATION RAIN-ON-SNOW EVENTS,
Nevada Univ., Reno. Desert Research Inst.
For primary bibliographic entry see Field 02B.
W69-04939

AN HOURLY WATER BALANCE MODEL AS A BASIS FOR CONTINUOUS WATER RESOURCES ASSESSMENT ON A WATERSHED,
Ontario Agricultural Coll., Guelph. School of Agricultural Engineering; Ceskoslovenska Akademie Ved, Prague. Inst. of Hydrodynamics.
H. D. Ayers, and J. Balek.
Int Ass Sci Hydrol Pub No 76, Symp on Hydrol Aspects of Util of Water, Bern, Sept 25-Oct 7, 1967, pp 227-234, 1968. 8 p, 3 fig, 7 ref.

Descriptors: *Model studies, *Hydrologic budget, *Watersheds (Basins), Hydrographs, Evapotranspiration, Storage, Groundwater movement, Ice, Streamflow, Meteorology, Climatology.
Identifiers: Hydrometeorology.

A mathematical model of the year-round hydrological regime has been developed. The model is based on various storage-accretion-depletion zones arranged vertically and two horizontally distributed regions corresponding to the alluvial and nonalluvial portions of the basin. The principles of the model structure and its application to a particular watershed are discussed. The model was tested by comparing observed and calculated hydrographs. (Knapp-USGS)
W69-04954

ESTIMATION OF MAXIMUM DISCHARGES AND HYDROGRAPHS OF FLOOD,
Gidrometeorologicheskii Institut, Leningrad (USSR).
For primary bibliographic entry see Field 02E.
W69-04955

INLET HYDROGRAPH ESTIMATION FOR LINEAR FLOW MODELS ACCORDING TO OUTLET HYDROGRAPH,
Hydrometeorological Centre (USSR).
L. S. Kuchment.
Int Ass Sci Hydrol Pub No 76, Symp on Hydrol Aspects of Util of Water, Bern, Sept 25-Oct 7, 1967, pp 292-299, 1968. 8 p, 3 fig, 1 tab, 6 ref.

Descriptors: Hydrograph analysis, *Routing, *Hydrographs, *Estimating, Mathematical studies, Analytical techniques, Approximation method, Rainfall-runoff relationships.
Identifiers: Duhamel's integral, Quasilinearization.

The problem of calculating the input hydrograph using the output hydrograph and Duhamel's integral is considered. Previously the problem was solved by using Volterra's equation of the first kind and is incorrect in the general case. In recent work in the USSR, Duhamel's integral was replaced by a system of linear algebraic equations solved approximately for the ordinates of the input hydrograph, assuming that input and output are equal. The method and procedure are described in detail. Examples of calculated hydrographs are compared with measured hydrographs. (Knapp-USGS)
W69-04961

RIVER POLLUTION II, CAUSES AND EFFECTS,
Louis Klein.
Washington: Butterworth and Company, 1962.

Descriptors: *Water pollution, *Rivers, *Foreign countries, Water pollution sources, Water pollution effects, Bodies of water, Running waters, Streams, Surface waters, Geographical regions, Regions.

The causes of river pollution and the nature of the various kinds of pollution and their effects upon rivers are described. The international chapter on river pollution is well-documented by the variety of countries from which these references emanate, namely: Great Britain, Germany, Holland, Belgium, France, Switzerland, Denmark, USSR, U.S.A., Argentina, Japan, South Africa, New Zealand, and Israel.
W69-05012

INTERRELATIONSHIP BETWEEN PHYSIOGRAPHY, HYDROLOGY, SEDIMENTATION, AND SALINIZATION OF THE LODDEN RIVER PLAINS, AUSTRALIA,
Geological Survey of Australia, Melbourne.
P. G. Macumber.
Jour of Hydrology, Vol 7, No 1, pp 39-57, 1969. 5 fig, 2 tab, 18 ref.

Descriptors: *Geomorphology, *Hydrology, *Sedimentation, *Saline water, *Quaternary period, Saline soils, Aquifers, Playas, Leaching, Flow rates, Streams, Semiarid climates, Salts, Irrigation effects, Winds, Climatology, Paleoclimatology.
Identifiers: *Lodden River Plains, Australia, Salinization, Plains, Playettes, Lunettes.

Salinization of the Lodden Plains was shown to be closely linked to fluvial and aeolian patterns of Quaternary sedimentation and hence strongly influenced by structural and geomorphic factors controlling sedimentation. The Lodden Plains have a semi-arid climate. Physiography of the Plains and development of playettes, playas and lunettes on the Plains were discussed. Salt content on the plain began to build up when flood control measures prevented regular seasonal flooding which leached salts down to the water table. Regular irrigation since 1884 has raised the water table to within 2 meters of the surface causing great loss in production of crops. (Affleck-Arizona)
W69-05079

EFFECTS OF HERBICIDES, BURNING, AND SEEDING DATE IN RESEEDING AN ARID RANGE.
Agricultural Research Service, Pullman, Wash. Crops Research Div.; Agricultural Research Service, Beltsville, Md. Crops Research Div.; Oregon State Univ., Corvallis.
W. C. Robocker, Dillard H. Gates, and Harold D. Kerr.
J. Range Management, Vol 18, No 3, pp 114-118, May 1965. 4 tab, 10 ref.

Descriptors: *Seeds, *Range grasses, *Revegetation, *Herbicides, *Burning, Range management, Planting management, Arid climates, Wheatgrasses, Brush control, Sagebrush, Bluegrasses, Crop response, Bromegrass, Washington.
Identifiers: *Reseeding, Seed bed, Perennial grasses, Climatic stress.

A study was conducted in the arid sagebrush-bluebunch wheatgrass association near Ephrata, Washington, to determine effectiveness both of burning and of several herbicides (Dalapon, 2, 3, 6-TBA, and CTPC) for seedbed preparation when seeding perennial grasses. The soil was a stony phase of Ephrata sandy loam. Neither the application of herbicides nor burning for control of downy brome and Sandberg's bluegrass before planting wheatgrass were effective in increasing stands of wheatgrass seedlings. In the study area, where dry summers and approximately 8 inches of annual precipitation were common, severe climatic stresses were primarily responsible in determing the establishment or failure of seedlings. (Blecker-Arizona)
W69-05082

FURTHER STUDY OF AQUIFER PERFORMANCE,
Illinois Univ., Urbana.
Walter Rose.
Illinois Water Resources Center, Research Report No 7, January 1967, i + 6 p, 7 ref. OWRR Project A-002-ILL.

Descriptors: *Aquifers, Boundaries, Darcys law, Diffusion, *Free surfaces, Groundwater, *Groundwater flow, Heat transfer, *Interfaces, Numerical analysis, Pores, Porosity, *Porous media.
Identifiers: Aquifer performance, *Boundary conditions, *Non-equilibrium thermodynamics, *Numerical methods, *Pore geometry.

The research objective was to develop a generalized treatment of reservoir engineering principles which underlie, describe, and control the performance of aquifers used for sources, storage and conduits of water. The work proceeded on three fronts: (a) new approaches to fluid transport, diffusion, dispersion, and heat transfer based on modern concepts of continuum mechanics and non-equilibrium thermodynamics, (b) characterization of microscopic details of pore geometry in aquifer systems, and (c) development of finite difference algorithms to model three-dimensional, unsteady fluid flow problems with free surface boundaries. Findings with respect to these areas include: (a) a general theory which holds for coupled processes where diffusion and heat transfer occur simultaneously, (b) suitable models to characterize pore space, and (c) a numerical difference scheme to model water motion with free surface boundary conditions as governed by the Navier-Stokes equations in the microscopic sense and by the Fourier diffusivity equation in the macroscopic sense. (Betchart-Ill)
W69-05149

2B. Precipitation

AREAL SPREAD OF THE EFFECT OF CLOUD SEEDING AT THE WHITETOP EXPERIMENT,
California Univ., Berkeley. Dept. of Statistics.
For primary bibliographic entry see Field 03B.
W69-04775

A LOW INTENSITY RAIN SIMULATOR FOR LONG DURATION RAIN-ON-SNOW EVENTS,
Nevada Univ., Reno. Desert Research Inst.
S. T. Timko, and C. M. Skau.
Water Resources Res Center Proj Rept No 12, Oct 1968. 9 p, 2 fig, 13 ref. OWRR Project B-012-NEV (1).

Descriptors: *Rainfall simultaors, *Artificial precipitation, *Rainfall runoff relationships, *Snowpacks, *Frozen ground, Infiltration, Runoff, Rainfall intensity, Simulated rainfall, Raindrops, Nevada.
Identifiers: Sierra Nevada, Rain-on-snow experiments.

A rain simulator was constructed to produce drop size distribution and intensity similar to those in winter storms on the east side of the Sierra Nevada. The simulator can independently regulate drop size from 0.1 to 1.5 mm and rainfall intensity from 0.03 to 1.5 in. per hr by using air jets concentric around water feed tubes to break up a regulated amount of water into drops of selected sizes. Intensity is regulated by varying the number of nozzles and the feed rate. Drop size is regulated by varying the airflow rate. Field trials were run in December and January in the Sierra Nevada above Carson City. The experiments were rain on snow and rain on frozen soil infiltration tests using bounded plots. Water equivalent, plot runoff, air temperature, soil temperature and soil moisture were measured while rainfall intensity was regulated. The apparatus worked satisfactorily but the data collection system needed further development, largely in automation because of the long time span of experiments and the rainfall simulator's demands on operator attention. (Knapp-USGS)
W69-04939

CHEMICAL CHARACTERISTICS OF BULK PRECIPITATION IN THE MOJAVE DESERT REGION, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 02K.
W69-04982

PROBABLE MAXIMUM PRECIPITATION OVER SOUTH PLATTE RIVER, COLORADO AND MINNESOTA RIVER, MINNESOTA,
Weather Bureau, Silver Spring, Md.
For primary bibliographic entry see Field 04A.
W69-05158

CLIMATOLOGY OF SEVERE WINTER STORMS IN ILLINOIS,
Stanley A. Changnon, Jr.
Illinois State Water Survey, Urbana, Bulletin 53, 1969. 45 p, 38 fig, 32 tab, 29 ref.

Descriptors:
Identifiers: *Applied climatology, Blizzards, Design storms, *Glaze, Heavy snow, Hydrologic budget, Ice storms, *Illinois, Lake effect, *Severe storms, Sleet, *Snow, *Storm damages, Storm models, Synoptic climatology, Wind with glaze.

Severe winter storms, those producing 6 inches or more snowfall and/or damaging glaze, occur five times a year in Illinois, and cause more damage than other forms of severe weather. The climatology of all severe winter storms in 1900-1960, their damages, their synoptic weather conditions, and information applicable to design and operational considerations are presented. Storms centered most often in northwestern Illinois and averaged 6 inches of snow over 7500 square miles. Storm centers were elongated with an axial ratio of 3:1 and WSW-ENE orientations. Point snowfalls of 12 inches and glaze with a radial thickness of 2 inches have occurred in all parts of Illinois. Business losses resulting from winter storms are eight times the direct losses to property and vegetation, and the greatest direct loss was $12.4 million in a 1924 storm. Five synoptic weather types cause severe winter storms, and the Colorado low with a southerly track produced 45 percent of all storms.
W69-05159

2C. Snow, Ice, and Frost

PARTICLE SIZE AS A BASIS FOR PREDICTING FROST ACTION IN SOILS,
National Research Council of Canada, Ottawa (Ontario).
E. Penner.
Soils Found, Vol 8, No 4, pp 21-29, Dec 1968. 9 p, 3 fig, 7 ref.

Descriptors: *Grain sizes, *Frost action, *Frost heaving, Heaving, Ice pressures, Pores, Gradation, Clays, Soils, Soil mechanics, Permeability, Frost, Frozen soils, Gradation analysis, Lenses (Soils), *Ice-water interfaces, Foreign research, Particle size.
Identifiers: Pore size, Soil pore structure, Ice lenses, Ice forming, Suction, Canada.

Maximum heaving pressures caused by ice lens growth were determined experimentally for saturated specimens consisting of fragmental particles in several size ranges. The size of smaller particles in the soil for the range of particle size studied determines the magnitude of the heaving pressure developed because of their influence on the dimensions of the porous system. Frost action criteria, based on particle size, appear adequate for predicting frost susceptibility. Maximum heaving pressure develops after active frost penetration and rises to this maximum when the ice-water interface is essentially stationary. There does not appear to be sharp separation, based on particle or pore size, of frost-heaving from nonfrost-heaving soils. The experimental observation that smaller sizes are more influential in determining maximum heaving pressure indicates that on a microscopic scale an undulating ice-water interface exists. The undulating feature of the ice lens is possible in a porous system of varying pore sizes exposed to a thermal gradient regime. Both are essential features of the mechanism of ice lensing in nature and also simulated in these experiments. (USBR)
W69-04739

A LOW INTENSITY RAIN SIMULATOR FOR LONG DURATION RAIN-ON-SNOW EVENTS,
Nevada Univ., Reno. Desert Research Inst.
For primary bibliographic entry see Field 02B.
W69-04939

THE UNDERSIDE OF RIVER ICE, ST. CROIX RIVER, WISCONSIN,
Geological Survey, Madison, Wis.
Kevin L. Carey.
Geol. Surv Res 1967, Prof Pap 575-C, pp C195-C199, 1967. 5 p, 1 fig, 1 tab, 2 ref.

Descriptors: *Ice, *Rivers, *Roughness (Hydraulic), *Ice-water interfaces, Wisconsin, Frazil ice, Mannings equation, Darcy-Weisbach equation.
Identifiers: St. Croix River (Wis), Ice configuration (Underside).

Ripplelike and dunelike features have been found during a second winter on the underside of the ice cover on the St. Croix River, Wis. Profiles of the features and measurements of ablation and accretion show that the features began to form when the underside of the ice was accreting, and continued their development during ablation. The Belokon-Sabaneev formula satisfactorily shows the relationship between the roughness coefficients for the ice, the bed, and the total channel. Calculations of the roughness coefficient for the underside of the ice, n sub 1, range from 0.0039 to 0.0142, except for one calculation which indicates no retardation of the flow by the ice cover. This anomaly is believed to be caused by an incorrect estimate of the effective size of the roughness projections of the bed. Caution is therefore given that the computed (published) values of the ice roughness parameters are slightly smaller than actual. (USGS)
W69-04976

WINTER LOSS AND SPRING RECOVERY OF DISSOLVED SOLIDS IN TWO PRAIRIE-POTHOLE PONDS IN NORTH DAKOTA,
Geological Survey, Lincoln, Nebr.
For primary bibliographic entry see Field 02J.
W69-04983

NET, ALLWAVE RADIATION AS AN INDEX OF NATURAL SNOWMELT AND SNOWMELT ACCELERATED WITH ALBEDO REDUCING MATERIALS,
Forest Service (USDA), Boise, Idaho. Intermountain Forest and Range Experiment Station.
Walter F. Meghan, James R. Meiman, and Bertram C. Goodell.
Proc. Internatl. Hydrology Symp. Colorado State U., 1967, pp 149-156.

Descriptors: *Snowmelt, *Albedo, *Solar radiation, *Energy transfer, Evaporation, Lysimeters, Meteorology, Melt water, Snow managment, Snowpacks, Snow removal, Irradiation, Wavelengths.
Identifiers: Air-snow interfaces, Net radiation, All wave radiation.

An evaluation of the utility of net radiation as an index of snowmelt in the open was made as part of a study in the Rocky Mountains of Colorado to evaluate methods of accelerating snowmelt by decreasing the albedo of snow. Snowmelt was measured with the use of clear, false bottom, lucite lysimeters, 41 centimeters (16 inches) in diameter and 41 centimeters (16 inches) deep. Net radiation was recorded from two Funk, net allwave radiometers for daily periods over snow lysimeters either treated with carbon blacks or untreated. Two kinds and two application rates of carbon blacks were used. A bimetal type pyranometer was operated concurrently with the Funk radiometers to measure incoming, short-wave radiation. Five days of records were used to relate radiant energy to snowmelt under extreme ranges of snow albedo. The correlation coefficient was .95 using the net allwave radiation data. Snowmelt was accelerated an average of 2.8 times with the use of albedo reducing materials for a one day period. There was no significant difference in the amount of melt among the various carbon black treatments. Estimates were made of the evaporation loss from snow. There was some indication that carbon black treatments reduce snow evaporation.
W69-05103

SNOW LOADS ON ROOFS IN AREAS OF HEAVY SNOWFALL,
Forest Service (USDA), Logan, Utah. Intermountain Forest and Range Experiment Station.
Robert D. Doty, and Glenn H. Deitschman.
U.S.D.A. Forest Serv. Res. Note INT-43, 1966, 4 pp.

Descriptors: *Snow surveys, Snowfall, *Snowpacks, *Weather data, Moisture content, Aluminum.
Identifiers: *Snow depth measurements.

This study tested the feasibility of estimating snow loads on roofs from measurements of depth and water content of snow on nearby ground. The water content, and therefore the weight, of snow on the ground proved comparable to that of snow on roofs.
W69-05109

CLIMATOLOGY OF SEVERE WINTER STORMS IN ILLINOIS,
For primary bibliographic entry see Field 02B.
W69-05159

2D. Evaporation and Transpiration

EVAPOTRANSPIRATION-REVIEW OF RESEARCH,
Nebraska Univ., Lincoln. Dept. of Horticulture and Forestry.
Norman J. Rosenberg, Hoyt E. Hart, and Kirk W. Brown.
Nebr Univ-Water Resources Res Inst Rep, Nov 1968. 78 p, 240 ref. OWRR Project A-001-NEBR (3).

Descriptors: *Evapotranspiration, *Reviews, *Bibliographies, Advection, Climatology, Energy budget, Hydrologic budget, Evaporation, Lysimeters, Meteorology, Micro-environment, Transpiration.
Identifiers: Evapotranspiration review.

The literature of evapotranspiration is reviewed, selected references are listed, and the drought problems in the Great Plains are discussed. Orginal source materials from the earliest available to 1967 are evaluated. Mass transport, aerodynamics, energy budget, and empirical methods are discussed in detail. Advection, a new field of interest not yet well understood, is emphasized and many references are reviewed and listed. Lysimetry is stressed because it appears to be the most promising technique for new research in evapotranspiration. Older review articles are reviewed to summarize earlier work and to help give a general background to evapotranspiration research. (Knapp-USGS)
W69-04764

EFFECTS OF PHENYLMERCURIC ACETATE ON TRANSPIRATION AND GROWTH OF SMALL PLOTS OF GRASS,
Nottingham Univ. (England). Dept of Horticulture.
D. C. Davenport.
Nature, Vol 212, No 5064, pp 801-802, November 19, 1966. 3 fig.

Descriptors: *Grasses, *Fescues, *Transpiration control, *Plant growth, *Inhibitors, Moisture stress, Carbon dioxide, Soil moisture, Metabolism, Stomata, Wetting, Soil-water-plant relationships, Retardants, Drying.
Identifiers: *Phenylmercuric acetate (PMA), Transpirometers, Plots.

Experiments were conducted to determine whether any concentration of the metabolic inhibitor phenylmercuric acetate (PMA) could be used to achieve a reduction of transpiration without substantially restricting the transfer of carbon dioxide or adversely affecting growth. Small plots of creeping red fescue grass were used as transpirometers, providing a highly reproducible method of assaying both transpiration and growth under a variety of environmental conditions. PMA was more effective under conditions of low soil moisture stress. The effects of the anti-transpirant could be detected within 24 hours and transpiration continued to be reduced, though with diminishing intensity, for as long as 4 weeks after application. No toxic effects were observed even with the highest rate of application of 4.8 gms of solution per plot. (Blecker-Arizona)
W69-05071

CALCULATION MODEL FOR THE ACTUAL EVAPOTRANSPIRATION FROM CROPPED AREAS AND OTHER TERMS OF THE WATER BALANCE EQUATION,
Research and Advisory Inst. for Field Crop and Grassland Husbandry, Wageningen (Netherlands).
G. F. Makkink, and H. D. J. van Heemst.
UNESCO Arid Zone Research, Vol 25, pp 489-494, 1965. 4 fig, 1 tab 20 ref, disc.

Descriptors: *Evapotranspiration, *Water balance, *Moisture content, *Drainage water, *Equations, Model studies, Correlation analysis, Soil moisture, Absorption, Precipitation (Atmospheric), Measurement.
Identifiers: Cropped area, Parameters.

A calculation model is given in which several processes are approximated quantitatively to arrive at the value of actual evapotranspiration of a cropped area and at all other terms of the water balance during the course of the year. The model is based on continuous water book-keeping of the water content in the soil throughout one or more years. Results obtained from the model not only give totals of drainage water, but also those of evapotranspiration, quantities of water absorbed from below and evapotranspiration deficits. A correlation coefficient of 0.91 has been found between the measured monthly quantities of drainage water and figures calculated by means of a schematic model for book-keeping of the water content of a cropped area. (Blecker-Arizona)
W69-05072

THE DETERMINATION OF THE EVAPORATION FROM THE PLANT COVER AND THE SURFACE OF THE SOIL BY RELATING LYSIMETER AND SOIL MOISTURE MEASUREMENTS TO POTENTIAL EVAPORATION,
O. Klausing.
UNESCO Arid Zone Research, Vol 25, pp 461-465, 1965. 1 fig, disc.

Descriptors: *Soil surfaces, *Evaporation, *Evapotranspiration, *Moisture content, *Measurement, Air temperature, Solar radiation, Soil water, Lysimeters, Ecology, Instrumentation, Water balance, Radiation, Soil moisture, Soil-water-plant relationships.
Identifiers: *Potential evaporation, Plant cover.

The theoretical problem of potential evaporation is discussed along with evapotranspiration. Also mentioned is the problem of providing a physical definition of potential evaporation acceptable to all and showing a practical way for its direct measurement. Potential evaporation is defined as evaporation from a plane horizontal water surface at actual air temperature in full daylight under conditions of unrestricted radiation and ventilation. Ecological measurement of evapotranspiration is one of the most complex problems in the field of ecology because soil surface and plant cover are dependent upon atmospheric and soil water conditions. A monolith-lysimeter in an ecologically natural position has apparently no effect on the soil surface. Its plant cover was constructed in order to satisfy all ecological requirements when potential evaporation was measured. (Blecker-Arizona)
W69-05073

PERPETUAL SUCCESSION OF STREAM-CHANNEL VEGETATION IN A SEMIARID REGION,
Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.
C. J. Campbell, and Win Green.
Jour of the Ariz Academy of Sci, Vol 5, No 2, pp 86-98, Oct 1968. 5 fig, 7 tab, 20 ref.

Descriptors: *Succession, *Channels, *Streams, *Vegetation, *Semiarid climates, Ecology, Arizona, Ecosystems, Plant groupings, Riparian plants, Speciation, Elevation, Shrubs, Trees, Desert plants, Soil-water-plant relationships, Floods, Soil moisture, Moisture, Availability, Vegetation regrowth.
Identifiers: *Association index, *Pseudoriparian, Sycamore Creek, Arizona.

Community aspects of channel vegetation with respect to changing elevation on Sycamore Creek, Maricopa County, Arizona, were studied by means of association indices of dominant species. Ninety-five percent of the shrub species samples and approximately fifty percent of the tree species were indigenous to the semiarid mountain slopes and were not dependent upon additional subsurface moisture in the channel for survival. These species were termed 'pseudoriparian'. Pseudoriparian species remained confined to their area of introduction--migrating neither upstream nor downstream. Riparian species existed only where additional subsurface moisture was available in addition to annual precipitation. Riparian species were found along the stream channel in a relatively narrow band that sometimes bisected sharply demarked vegetational zones. It was suggested that channel vegetation probably never reached a climax hierarchy due to periodic flood disturbances such as erosion, inundation and deposition. (Affleck-Arizona)
W69-05080

INFLUENCE OF THE THICKNESS AND FREE POROSITY OF A DRIED LAYER ON EVAPORATION,
Akademiya Nauk SSSR, Moscow. Institut Geografii.
L. K. Tselishcheva.
Soviet Soil Sci, No 3, pp 257-260, March 1965. 2 fig.

Descriptors: *Drying, *Evaporation, *Porosity, *Soil surfaces, *Soil density, Water vapor, Mulching, Equations, Diffusion, Moisture content, Air-earth interfaces, Temperature, Soil moisture, Density.

A dried layer, which performs the role of natural mulch through which moisture can move in a vaporous state, will be formed on the soil surface during evaporation. The purpose of this study was to obtain additional data on a formula which shows the ratio of evaporation from dried soil to the evaporation from the surface of wet soil and secondly, to explain the nature of the relation between a coefficient which determines the water vapor diffusion rate through a dried layer or mulch and free porosity of the soil. Results indicated that the ratio of evaporation from dried soil and wet soil described accurately the influence of the thickness of a dried soil layer or mulch on evaporation. The equations developed could be used to determine the quantity of moisture that is lost to evaporation in arid climates. (Blecker-Arizona)
W69-05083

DETERMINATION OF THE REGIONAL COEFFICIENT 'K' FOR COMPUTING THE CONSUMPTIVE USE OF NATIVE BLACK KIDNEY BEAN IN THE IRRIGATION DISTRICTS OF VERACRUZ STATE,
Irrigation and Drainage Engineering Office, Veracruz (Mexico).
For primary bibliographic entry see Field 02I.
W69-05086

CONSUMPTIVE USE OF WATER FOR SOME MAJOR CROPS IN U.A.R. (EGYPT),
Cairo Univ., Giza (Egypt). Dept. of Irrigation and Hydraulics, Ministry of Agriculture, Cairo (Egypt).
For primary bibliographic entry see Field 02I.
W69-05087

INFLUENCE OF SOIL WATER POTENTIAL AND ATMOSPHERIC EVAPORATIVE DEMAND ON TRANSPIRATION AND THE ENERGY STATUS OF WATER IN PLANTS.
Utah State Univ., Logan.
For primary bibliographic entry see Field 02I.
W69-05088

CONSUMPTIVE USE COMPUTATIONS FROM EVAPORATION PAN DATA,
George H. Hargreaves.
Irrigation and Drainage Conference, Las Vegas, Nevada, Nov 2-4 1966, American Society of Civil Engineers, pp 35-64. 5 tab, 21 ref, disc.

Descriptors: *Evapotranspiration, *Consumptive use, *Evaporation pans, *Crops, *Water requirements, Arid climates, Evaporation, Rainfall, Data collections, Equations, Irrigation efficiency, Climatic data, Analytical techniques, Computers.
Identifiers: *Formulas.

The history of development of evaporation and evapotranspiration (consumptive use) formulas in given and improved evaporation formulas are presented. Ratios of evapotranspiration to Class A pan evaporation are studied for a large number of crops. Crops are grouped according to similar irrigation requirements and similar relationships to evaporation. A comprehensive system of irrigation requirement computations is developed. A formula is presented for converting consumptive use to irrigation requirements by allowing for a suitable irrigation efficiency and for utilizable rainfall. The methods and procedures presented area applicable to arid climates where data are quite complete as well as to those locations or projects for which only temperature and rainfall data are available. (Blecker-Ariz)
W69-05092

ESTIMATING CONSUMPTIVE USE - MUNSON P. E. INDEX METHOD,
Bureau of Reclamation, Washington, D. C.
Wendell C. Munson.
Irrigation and Drainage Speciality Conference, Las Vegas, Nevada, Nov 2-4, 1966, American Society of Civil Engineers, pp 65-107. 8 tab, 4 illus.

Descriptors: *Consumptive use, *Semiarid climates, *Temperature, *Evapotranspiration, *Estimating, Evaporation, Transpiration, Precipitation (Atmospheric), Monthly, Annual, Crop production, Irrigation efficiency, Climatic data, Water requirements, Measurement.
Identifiers: *Munson P.E. Index Method, Formulas.

The purpose of this paper was to update previous work that used the Munson P.E. Index, discuss problems encountered and their possible solutions, and correct some misconceptions of basic factors included in the formula. Procedures are described for adapting the formula to areas other than semiarid sections of the United States. The method described showed that monthly and annual consumptive use estimates may be determined for project formulation utilizing only average monthly temperatures and a set of predetermined P. E. ratios. Results obtained by the method have been compared with those obtained by many other methods over a wide geographical range and a great divergence in cropping procedures as well as different crops have been found. Validity of the method has been shown to be comparable to that of any other method and has the advantage of its extreme simplicity. (Blecker-Ariz)
W69-05094

EVAPORATION RATES IN MOUNTAINOUS TERRAIN,
Forest Service (USDA), Logan, Utah. Intermountain Forest and Range Experiment Station.
Eugene L. Peck, and Dale J. Pfankuch.
I.A.S.H. Committee for Evaporation, Publication No. 62, 1963, pp 267-278.

Descriptors: *Evaporation, *Mountains, *Gaging stations, *Meterological data, *Hydrologic data, Elevation, Atmospheric pressure, Radiation, Dew point, Wing velocity, Watershed management, Anemometers, Thermometers, Evaporation pans.
Identifiers: *Evaporation rates, *Evaporation stations, *Diurnal rates, Drainage winds.

An investigation of evaporation rates in mountainous terrain is being conducted with a specially designed network of 13 Weather Bureau 'Class A' evaporation stations at elevations ranging from 4,400 to 9,000 feet in the Wasatch Mountains near Farmington, Utah. The investigation seeks to determine the effects of elevation, topography, and exposure on evaporation rates. Measurements during the first summer consisted of daily readings at all stations and simultaneous hourly readings from sunrise to sunset for the base station and each other station on an alternating basis. Analyses of the data are presented, including comparison of evaporation rates from the different stations, for pairs of stations near the same elevation with different exposures, as well as comparison of daytime and nighttime evaporation rates. The effect of drainage winds on nighttime evaporation is noted.
W69-05098

INFLUENCE OF SOIL TEMPERATURE ON TRANSPIRATION UNDER VARIOUS ENVIRONMENTAL CONDITIONS,
Forest Service (USDA), Logan, Utah. Intermountain Forest and Range Experiment Station.
R. K. Tew, S. A. Taylor, and G. L. Ashcroft.
Agronomy Journal, 1963, Vol. 55:558-560.

Descriptors: *Transpiration, *Environmental effects, *Air temperature, *Relative humidity, *Soil temperature, Soil physical properties, Soil-water-plant relationship, Evapotranspiration, Root development, Soil water movement, Growth chambers, Wind velocity, Capillary water, Soil stability, Lighting.
Identifiers: *Leaf temperatures, *Stem temperatures, Root membrane permeability.

Soil temperature had a significant influence on transpiration. In growth chambers, variations in air temperature and relative humidity had little influence on transpiration when the soil temperature was low. Under the experimental conditions, low soil temperature was a major factor in controlling transpiration rates.
W69-05099

EVAPOTRANSPIRATION AND SOIL-MOISTURE DEPLETION,
Forest Service (USDA), Moscow, Idaho. Intermountain Forest and Range Experiment Station.
For primary bibliographic entry see Field 02G.
W69-05102

2E. Streamflow and Runoff

HYDROGRAPHICAL INVESTIGATION OF THE BRAHMAPUTRA RIVER IN EAST PAKISTAN,
East Pakistan Water and Power Development Authority, Dacca. Water Investigation.
A. Latif.
For the 8 Volume Proceedings, see Vol 2, No 9, Field 06B, W69-03305. Int Conf on Water for Peace, Wash D C, Vol 4, pp 309-319, 1968. 11 p, 4 fig, 1 tab, 5 ref.

Descriptors: *Hydrograph, *Alluvial channels, *Floods, *Rivers, *River basin development, Data collections, Investigations, Hydrologic data, Social aspects, Agriculture, Regional analysis, Surveys, River forecasting, Channel improvement, Flood protection, Levees.
Identifiers: Brahmaputra River (Pakistan).

Brahmaputra is the largest river in the Indo-Pakistan sub-continent. The river rises in the northernmost ranges of the Himalayas in the Tibet and, flowing through Assam in India, enters East Pakistan. At Goalundo in East Pakistan it meets the Ganges river and after meeting the Meghna river at Chandpur discharges into the Bay of Bengal. The length of the river from the source to Goalundo is 1,600 mi. The average annual precipitation over the whole river basin is 85 in. The flood flows of the river are among the largest in the world. The estimated maximum discharge in the river channel was 2.5 million cusecs and annual sediment-load is about 900 million tons. Three successive damaging floods occurred in East Pakistan in 1954-56. A U.N. Technical Mission, which carried out a study of the problem of water development in East Pakistan, recommended investigation of the feasibility and effects, beneficial and adverse, of a system of flood embankments along the major rivers with sluices, flushing channels and drainage channels. During the last 12 yr East Pakistan has been subjected to 6 severe floods inundating each time about 12,000 to 15,000 sq mi, which represents about half of the cultivated area of the province. The density of population in the flooded areas of the Brahmaputra basin in East Pakistan varies from 1,000 to 16,000 sq mi. With the growth of population the pressure for living space and food is assuming greater importance. Control of floods by storage dams is not possible as the upper reaches of the river lie outside Pakistan. Construction of an embankment on the right bank of the river in East Pakistan is in progress. It is proposed also to construct marginal embankments on the left bank of the Brahmaputra. Results of a preliminary survey of the effects of earthquakes and landslides upstream of Pakistan are discussed. (Knapp-USGS)
W69-04752

BASIC DATA COLLECTION FOR WATER DEVELOPMENT IN EAST PAKISTAN,
East Pakistan Water and Power Development Authority, Dacca. Water Investigation.
For primary bibliographic entry see Field 07A.
W69-04755

A STUDY OF WATER RESOURCES IN THE CANBERRA AREA AND THE QUEANBEYAN RIVER WATERSHED (GOOGONG DAM CATCHMENT),
Northern Illinois Univ., DeKalb. Dept. of Earth Sciences.
Loren T. Caldwell.
Water Resources Bull, Vol 4, No 4, pp 15-27, Dec 1968. 13 p, 6 fig, 3 tab, 7 ref.

Descriptors: *Water resources, *Groundwater, *Surface waters, *Hydrologic budget, Data collections, Hydrologic data, Streamflow, Water levels, Water level fluctuations, Temperature, Rainfall, Evaporation, Hydrographs.
Identifiers: Australia, Queanbeyan River (Australia).

Data provided by the Australian Commonwealth Bureaus of Meteorology and Mineral Resources are used in a water budget study of the Queanbeyan River watershed. Air and soil temperatures show close correlation from month to month during the five-year period. A close parallel also exists for the air temperature values and the seasonal variations in the Nett-Moisture (rainfall minus evaporation) plots. Groundwater levels appear to be influenced by drought periods and by underground water storage conditions. The groundwater levels were unusually high early in the drought year of 1964-65. The annual rainfall totals for 1962, 1963, and 1966 were all exceeded by the evaporation totals. In 1964 and in 1965 (the drought year) the evaporation total exceeded the rainfall total. The minimum annual water discharge values for the Queanbeyan River ranged from 4.9 in. in 1963 to 1.4 in. in 1965. (Knapp-USGS)
W69-04757

ELECTRONIC DATA PROCESSING SYSTEM FOR STREAMFLOW,
Southern Great Plains Watershed Research Center, Chickasha, Okla.
For primary bibliographic entry see Field 07C.
W69-04759

SURFACE AND SUBTERRANEAN HYDROLOGY IN ITS APPLICATION TO THE STUDY OF THE MODAVE KARSTIC AQUIFER IN BELGIUM (FRENCH),
Bordeaux Univ., (France).
Joseph Agie de Selsaten.
Bull Int Assoc Sci Hydrol, Vol 13, No 1, pp 49-57, Feb 1968. 9 p, 4 fig, 10 ref.

Descriptors: *Mathematical studies, *Mathematical models, *Aquifers, *Karst, Hydrologic properties, Runoff, Discharge (Water), Water sources, Topography, Limestones, Carbonate rocks, Hydrograph analysis, Floods, Hydraulic properties, Climatic data, Dry seasons, Darcys law, Basins, Hydrogeology.
Identifiers: Karstic zone, Modave, Belgium.

Surface and groundwater runoffs of the Modave karstic area were analyzed on the basis of mathematical formula developed by Boussinesq and later modified by Maillet and Schoeller (1962). The study shows that the aquifer of this karstic area consists of marine limestones and some dolomite. The Bonne, Hoyoux, and Ry de Pailhe rivers drain the area. A strong parallelism is shown between the surface and subterranean runoffs. The values of decrease in coefficients computed for various runoffs of the zone can be easily compared with those found in other basins. (Gabriel-USGS)
W69-04762

SURFACE WATER DATA, QUEBEC, WATER YEAR 1964.
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.

Inland Waters Br, Dep Energy, Mines and Resources Data Rep, 1969. 294 p.

Descriptors: *Data collections, *Surface waters, *Streamflow, Discharge (Water), Stream gages, Lakes, Reservoirs, Stage-discharge relations.
Identifiers: Canada, Quebec, Surface water records, Water resources data.

The surface-water records for the 1964 water year for gaging stations, partial-record stations, and miscelleneous sites in Quebec are presented. The data generally comprise a description of the station and a table showing the daily discharge and monthly and yearly discharge of the stream. The description of the station gives the location, drainage area, records available, type and history of gages, average discharge, extremes of discharge, and general remarks. Information on the accuracy of the records and conditions which affect the natural flow is given under 'Remarks.' Daily discharges, average discharge, extremes, yearly totals, and peak discharges are listed. (Knapp-USGS)
W69-04768

FLOOD PLAIN INFORMATION, SANTA FE RIVER, SANTA FE, NEW MEXICO.
Corps of Engineers, Albuquerque, N. Mex.
For primary bibliographic entry see Field 04A.
W69-04783

FLOOD PLAIN INFORMATION, CROW RIVER, ROCKFORD, MINNESOTA.
Corps of Engineers, St. Paul, Minn.
For primary bibliographic entry see Field 04A.
W69-04784

FLOOD PLAIN INFORMATION, LOWER LAS VEGAS WASH, CLARK COUNTY, NEVADA.
Corps of Engineers, Los Angeles, Calif.
For primary bibliographic entry see Field 04A.
W69-04785

FLOOD PLAIN INFORMATION, MISSISSIPPI AND YAZOO RIVERS, VICKSBURG, MISSISSIPPI.
Corps of Engineers, Vicksburg, Miss.
For primary bibliographic entry see Field 04A.
W69-04786

FLOOD PLAIN INFORMATION, SOUTH FORK OF THE CROW RIVER, DELANO, MINNESOTA.
Corps of Engineers, St. Paul, Minn.
For primary bibliographic entry see Field 04A.
W69-04787

WATER RESOURCES APPRAISAL OF THOUSAND SPRINGS VALLEY, ELKO COUNTY, NEVADA,
Geological Survey, Carson City, Nev.
Eugene F. Rush.
Nev Dep Conserv and Nat Resources, Water Resources Reconnaissance Ser Rep 47. June 1968. 61 p, 3 fig, 1 plate, 20 tab, 18 ref.

Descriptors: *Water resources, *Groundwater, *Surface waters, *Nevada, Aquifers, Alluvium, Carbonates, Water yield, Water sources, Irrigation water, Water utilization, Stock water, Domestic water.
Identifiers: Thousand Springs Valley (Nev).

The sparsely populated Thousand Springs Valley is in northeastern Nevada and has an area of about 1,440 sq mi. Carbonate rocks and alluvium, which are abundant throughout the report area may transmit substantial parts of the valley's water resources. Agriculture, other than grazing, is limited to the mile-wide flood plain of Thousand Springs Creek, where hay and pasture land are irrigated. Sampled well and surface waters were generally chemically suitable for irrigation in the 3 western segments, but samples collected in Montello Valley were more highly mineralized. A table summarizes most of the estimated hydrologic quantities for the area. The average annual precipitation is 600,000 acre-ft, runoff 35,000 acre-ft, evapotranspiration 5,700 acre-ft, and water yield, 24,000 acre-ft. The quantity of water in transitional storage is about 2 million acre-ft. (Knapp-USGS)
W69-04791

SURFACE WATER DATA, BRITISH COLUMBIA, WATER YEAR 1966.
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.

Inland Waters Br, Dep Energy, Mines and Resources Data Rep, 1969. 579 p, 2 maps.

Descriptors: *Data collections, *Surface waters, *Streamflow, Discharge (water), Stream gages, Lakes, Reservoirs, Stage-discharge relations.
Identifiers: Canada, British Columbia, Surface water records, Water resources data.

The surface-water records for the 1966 water year for gaging stations, partial record stations, and miscellaneous sites in British Columbia are presented. The data generally comprise a description of the station and a table showing the daily discharge and monthly and yearly discharge of the stream. The description of the station gives the location, drainage area, records available, type and history of gages, average discharge, extremes of discharge, and general remarks. Information on the accuracy of the records and conditions which affect the natural flow is given under 'Remarks.' Daily discharges, average discharge, extremes, yearly totals, and peak discharges are listed. (Knapp-USGS)
W69-04792

FLOOD PLAIN INFORMATION, CHARLOTTE AND NORTH LEE COUNTIES, FLORIDA.
Corps of Engineers, Jacksonville, Fla.
For primary bibliographic entry see Field 04A.
W69-04918

FLOOD PLAIN INFORMATION, CAMPBELL CREEK, ANCHORAGE, ALASKA.
Corps of Engineers, Anchorage, Alaska.
For primary bibliographic entry see Field 04A.
W69-04919

FLOOD PLAIN INFORMATION, PUPUKEA, OAHU, HAWAII.
Corps of Engineers, Honolulu, Hawaii.
For primary bibliographic entry see Field 04A.
W69-04920

FLOOD PLAIN INFORMATION, AGUA FRIA RIVER, MARICOPA COUNTY, ARIZONA.
Corps of Engineers, Los Angeles, Calif.
For primary bibliographic entry see Field 04A.
W69-04921

FLOOD PLAIN INFORMATION, CHESTER CREEK, ANCHORAGE, ALASKA.
Corps of Engineers, Anchorage, Alaska.
For primary bibliographic entry see Field 04A.
W69-04922

FLOOD PLAIN INFORMATION, CHAGRIN RIVER, LAKE AND CUYAHOGA COUNTIES, OHIO.
Corps of Engineers, Buffalo, N. Y.
For primary bibliographic entry see Field 04A.
W69-04923

FLOOD PLAIN INFORMATION OF PURPLE CREEK IN VICINITY OF JACKSON, MISSISSIPPI.
Corps of Engineers, Mobile, Ala.
For primary bibliographic entry see Field 04A.
W69-04924

FLOOD PLAIN INFORMATION, CUYAHOGA RIVER, BIG CREEK AND TINKERS CREEK, CUYAHOGA COUNTY, OHIO.
Corps of Engineers, Buffalo, N. Y.
For primary bibliographic entry see Field 04A.
W69-04925

FLOOD PLAIN INFORMATION, BLACK HAWK CREEK, BLACK HAWK COUNTY, IOWA.
Corps of Engineers, Rock Island, Ill.
For primary bibliographic entry see Field 04A.
W69-04926

ANNUAL PEAK DISCHARGES FROM SMALL DRAINAGE AREAS IN MONTANA THROUGH SEPTEMBER 1968,
Geological Survey, Helena, Mont.
M. V. Johnson, and R. J. Omang.
Geol Surv - Mont State Highway Comm Annu Progr Rep, 1969. 139 p, 1 fig.

Descriptors: *Data collections, *Surface waters, *Streamflow, Floods, Montana, Small watersheds, Water year, Stream gages, Gaging stations, Stage-discharge relations.
Identifiers: Surface water records, Annual peak stage, Water resources data, Crest-gage stations.

Annual peak discharge records through the 1968 water year for gaging stations, and crest-gage stations on small watersheds in Montana are presented. The data generally comprise a description of the station and a table showing the peak stage and discharge of the stream. The description of the station gives the location, drainage area, records available, type and history of gages, annual maximum discharge, extremes of discharge, and general remarks. The type of gage currently in use and the datum of the gage above mean sea level, and a condensed history of the types, locations, and datums of previous gages used during the period of records available are listed. Information on the accuracy of the records and conditions which affect the natural flow is given. Peak discharges are tabulated. (Knapp-USGS)
W69-04927

STREAMFLOW SYNTHESIS FOR UNGAGED RIVERS,
Corps of Engineers, Sacramento, Calif. Hydrologic Engineering Center.
Leo R. Beard.
Int Ass Sci Hydrol Pub No 76, Symp on Hydrol Aspects of Util of Water, Bern, Sept 25-Oct 7, 1967, pp 98-109, 1968. 12 p, 6 tab, 4 ref.

Descriptors: *Streamflow forecasting, *Synthesis, Regression analysis, Statistical methods, Model studies, Correlation analysis, Statistical models, Routing, Flood routing, Stream gages, Stochastic processes.
Identifiers: Monthly streamflow forecasts.

The Hydrologic Engineering Center of the Corps of Engineers developed a mathematical model for simulating monthly streamflow. This model was tested extensively to assure that all characteristics of monthly average streamflow pertinent to water resources development are adequately described in the model. Model coefficients consist of frequency and correlation coefficients for each of the 12 calendar months and number 48 for a single location. These are far more numerous where more than one location must be considered simultaneously. For the purpose of deriving a monthly streamflow model for ungaged locations, these coefficients must be combined into a small number of generalized coefficients, which can feasibly be related to drainage basin characteristics. Generalized coefficients for simulating monthly streamflows have been developed with the requirements that important characteristics of flows generated using the generalized coefficients compare reasonably with those characteristics of recorded data at long-record stations throughout the United States. Means of establishing generalized model coefficients and generating hypothetical streamflows for ungaged locations are described. Such streamflows would form the basis for water resources studies in regions of little or no streamflow data.
W69-04932

DETERMINING STREAMFLOW ABSTRACTIONS FROM ANTECEDENT CONDITIONS,
Agricultural Research Service, Chickasha, Okla. Southern Plains Branch.
Russell R. Schoof, Monroe A. Hartman, and Charles G. Hunt.
Int Ass Sci Hydrol Pub No 76, Symp on Hydrol Aspects of Util of Water, Bern, Sept 25-Oct 7, 1967, pp 89-97, 1968. 9 p, 6 fig, 1 tab, 1 ref.

Descriptors: *Routing, *Floods, Oklahoma, Streamflow forecasting, Evapotranspiration, Floods, Overflow, Infiltration, Storage, Hydrographs, Hydrograph analysis, Stream gages, Runoff.
Identifiers: Streamflow abstractions, Washita River (Okla), Antecedent flow.

The abstractions including evapotranspiration, bank storage, and infiltrated overbank flow from 16 runoff events with peak mean-daily inflows varying from 500 to 10,000 cfs were studied in a 22-mile reach of the Washita River in southwestern Oklahoma. The flow abstractions varied from 5 to 77% of the events' peak mean-daily inflows. Net flow abstractions up to 12% and gains up to 6% were computed for 14-day events. Ten events gained and 6 lost volume in this study. High antecedent flow reduced the abstraction from 3 events. Abstractions from runoff were greater in the summer months when evaporation loss was great and the antecedent flow was low. Conversely, maximum gains were associated with the winter and early spring flows.
W69-04933

A NEW METHOD OF MAPPING THE WATER RESOURCES,
Northern Research Inst. of Hydraulic Engineering and Reclamation, Kazan (USSR). Dept. of Hydrology and Water Resources.
R. S. Petrova, E. M. Zinovyeva, and G. N. Petrov.

Int Ass Sci Hydrol Pub No 76, Symp on Hydrol Aspects of Util of Water, Bern, Sept 25-Oct 7, 1967, pp 60-64, 1968. 5 p.

Descriptors: *Streamflow forecasting, *Routing, *Water utilization, Water resources, Runoff, Flood forecasting, Water quality, Surveys, Geomorphology, Soils, Vegetation, Groundwater basins, Water resources development.
Identifiers: USSR, Water resources mapping, Ice surveys, Geobotanical surveys.

Maps of annual runoff isolines are necessary for perspective mapping and geographical descriptions, but they are not suitable for determining the water resources of certain rivers where local zone peculiarities of runoff distribution exist. A new method permits determination of the water resources of ungaged rivers during the most important periods of agriculture, low water and spring flood. Water resources during low water period are determined and mapped by means of hydrometric surveying which (if possible) should be made together with hydrochemical, thermometric, geobotanic and organoleptic surveys. If groundwater levels do not fluctuate, it is possible to calculate average values of base flow taking into account the types and categories of the underground waters feeding the rivers. For determining and mapping the water resources during spring flood, the observations made in a limited discharge zone should be aided by constructed hypothetical discharge flow nets in typical stretches of the river. Water resources of individual basins are measured by comparing conditions necessary to form the runoff. Three categories of accuracy are (a) determined by direct measurements; (b) determined by analyzing the geographical conditions and confirmed by the data of typical basins; and (c) determined by means of one analysis which must be checked for conditions in spring basins.
W69-04934

SEASONAL DISTRIBUTION AND REGULATION FOR FLOW RIVERS OF MOUNTAIN COUNTRIES,
Moscow State Univ. (USSR). Dept. of Land Hydrology.
V. D. Bykov.
Int Ass Sci Hydrol Pub No 76, Symp on Hydrol Aspects of Util of Water, Bern, Sept 25-Oct 7, 1967, pp 65-69, 1968. 5 p, 3 fig, 3 ref.

Descriptors: *Streamflow forecasting, *Synoptic analysis, Water resources, Runoff, Flood forecasting, Water resources development, Hydrograph analysis, Flow characteristics.
Identifiers: USSR.

The seasonal variation of flow of rivers originating in the mountainous areas of the USSR was studied. Runoff regimes were correlated with climatic conditions, altitude of river basins, surface geological structures, topography, and river length. Regions of similar runoff conditions were mapped. The general principles of streamflow regulation are briefly discussed in relation to problems in the USSR. (Knapp-USGS)
W69-04935

A METHOD OF DETERMINING THE AVAILABLE SURFACE WATER RESOURCES,
Institut fuer Wasserwirtschaft, Berlin (East Germany).
J. Hubner.
Int Ass Sci Hydrol Pub No 76, Symp on Hydrol Aspects of Util of Water, Bern, Sept 25-Oct 7, 1967, pp 70-76, 1968. 7 p, 2 fig, 1 ref.

Descriptors: *Water resources development, *Surface waters, *Streamflow forecasting, Surveys, Water resources, Hydrograph analysis, Probability, Statistical methods, Water balance.
Identifiers: Minimum monthly discharges.

Approximate water management balances have to show whether the probability of the available discharges corresponds to the probability required by water usage. The probabilities which must be calculated refer to all discharges, whereas random samples composed of the minimum monthly mean discharges of each year of the observation period - as they generally applied to characterize surface water resources - only relate to the frequency of years with discharges lower than the considered discharges without taking into account the duration of these discharges within the year. An approximative method of separating this part of the duration curve, which may be considered representative of all discharges, is obtained by transforming the frequency distributions of the minimum mean discharges of one, two or more consecutive months of each year. The application of this method also permits the selection of discharges apt to characterize the available surface water resources. (Knapp-USGS)
W69-04950

PLANNED UTILIZATION OF WATER RESOURCES,
TRW Systems, Redondo Beach, Calif.
M. L. Frankel.
Int Ass Sci Hydrol Pub No 76, Symp on Hydrol Aspects of Util of Water, Bern, Sept 25-Oct 7, 1967, pp 77-85, 1968. 9 p, 3 fig, 6 ref.

Descriptors: *Water resources development, *Planning, *California, *Inter-basin transfers, Hydrogeology, Computer programs, Digital computers, Groundwater basins, Water quality, Water demand, Water utilization, Economics, Irrigation.
Identifiers: San Bernardino Valley, California Water Project.

California's semiarid San Bernardino Valley, which relies heavily on groundwater, is experiencing a rapid grwoth in the face of diminishing water resources. To avert critical water shortages in the future, the State of California is engaged in a massive effort, the California Water Project, which includes the redistribution of the state's water resources. However, mass redistribution of Northern California water to Southern California does not solve the problems. The recipent of the water--in this case the San Bernardino Valley--must somehow manage its existing resources and imported water in an economic framework that promotes regional growth. Planned utilization of the Valley's water resources is a comprehensive project involving studies of the region's hydrology, geology, demography, and economy. The entire project is outlined, emphasizing the study of groundwater. The success of the project is keyed to a thorough understanding of available groundwater resources and their economic mix with imported water. A digital computer program was designed to simulate the region's groundwater supply and its interaction with imported water. A detailed description of the computer program and its relation to the overall project is included. (Knapp-USGS)
W69-04952

THE DISCHARGE RECESSION AS CRITERION ON THE RETENTION CAPACITY OF BASINS,
Institut fuer Wasserwirtschaft, Berlin (East Germany).
S. Narbe.
Int Ass Sci Hydrol Pub No 76, Symp on Hydrol Aspects of Util of Water, Bern, Sept 25-Oct 7, 1967, pp 162-167, 1968. 6 p, 4 fig.

Descriptors: *Recession curves, *Hydrograph analysis, River forecasting, Hydrographs, Retention, Storage, Routing, Streamflow forecasting.
Identifiers: Drainage basin retention.

The retention capacity of drainage basins is studied by analysis of the recession behavior of river discharges during dry periods. The retention capacity of the study areas is represented by exponential recession curves, or straight lines on semi-log paper with linear time scale. Geologically similar basins show similar shapes of discharge recession curves. Different areas have curves with different exponents. The base-flow portion of the recession curve used alone is less suited to characterize retention capacity than is the entire recession curve. (Knapp-USGS)
W69-04953

ESTIMATION OF MAXIMUM DISCHARGES AND HYDROGRAPHS OF FLOOD,
Gidrometeorologicheskii Institut, Leningrad (USSR).

D. L. Sokolovsky, and I. A. Skiklomanov.
Int Ass Sci Hydrol Pub No 76, Symp on Hydrol Aspects of Util of Water, Bern, Sept 25-Oct 7, 1967, pp 343-347, 1968. 5 p.

Descriptors: *Streamflow forecasting, *Flood forecasting, *Computer models, Hydrograph analysis, Routing, Stage-discharge relations, Unit hydrographs, Rainfall intensity, Rainfall disposition.
Identifiers: USSR, Travel time.

Some methods of estimation of the maximum discharges and flood hydrographs by use of electonic modeling equipment are described. The theory of 'time of travel' is established to account for the transformation of the runoff hydrograph in accordance with the Duhamel integral which is used in the unitgraph theory. The principal flood parameter is considered to be the value of time lag between maximum rainfall and runoff, as well as the coefficient of the flood shape defined as the relation between the time of fall and the time of rise of the hydrograph. In the estimation process, the time of travel may be considered either constant during flood (linear scheme) or changing, depending on the discharge variation (nonlinear scheme). In the water yield hydrograph, taking into account the runoff coefficient, the maximum discharges of rainfloods may be defined for gaged and ungaged streams. The flood parameters are defined in accordance with the area, slope and shape of this basin, the extent of the wooded land, and other physiographic and morphometric characteristics of a catchment area. The methods have been tested on many streams under different conditions and proved very economical in time and accuracy of results, especially in comparison with other methods. (Knapp-USGS)
W69-04955

CONTRIBUTION CONCERNING THE FLOW RATES OF RIVERS TRANSPORTING DRAIN WATERS OF OPEN-CAST MINES,
Wasserwirtschaftsdirektion, Cottbus (East Germany).
For primary bibliographic entry see Field 04C.
W69-04956

INLET HYDROGRAPH ESTIMATION FOR LINEAR FLOW MODELS ACCORDING TO OUTLET HYDROGRAPH,
Hydrometeorological Centre (USSR).
For primary bibliographic entry see Field 02A.
W69-04961

ANALYTICAL APPROACHES TO COMPUTATION OF DISCHARGE OF AN ICE-COVERED STREAM,
Geological Survey, Madison, Wis.
Kevin L. Carey.
Geol Surv Res 1967, Prof Pap 575-C, pp C200-C207, 1967. 8 p, 7 fig, 2 tab, 3 ref.

Descriptors: *Discharge measurement, *Streams, *Ice, Closed conduit flow, Open channel flow, Backwater, Stage-discharge relations, Current meters, Stream gages, Mannings equation, Darcy-Weisbach equation.
Identifiers: Pipe-flow equations, Velocity-discharge relations.

Two analytical methods for computing winter discharge of an ice-covered stream have recently been developed from observations on the St. Croix River, Wis. One method is based on pipe-flow equations, and the other method on an analogy with methods used to compute open-water for streams affected by backwater. Accuracy of computed discharge in the first method is within 19% of measured discharge, whereas the second method gives results within 9%. Relationships in both methods are developed with data either recorded or measured in the field. After the relationships have been developed for a particular stream-gaging station, only recorded data (water-surface stage at both ends of a reach) are needed to compute discharge. (USGS)
W69-04975

TWO METHODS OF ESTIMATING BASE FLOW AT UNGAGED STREAM SITES IN KANSAS AND ADJACENT STATES,
Geological Survey, Lawrence, Kan.; Geological Survey, Albany, N. Y.
L. W. Furness, and M. W. Busby.
Geol Surv Res 1967, Prof Pap 575-C, pp 208-211, 1967. 3 fig, 4 ref.

Descriptors: *Base flow, *Estimating, Estimating equations, Regression analysis, Current meters, Runoff, Kansas.
Identifiers: Ungaged streams, Base flow estimation.

In investigating a satisfactory technique for estimating base flow (a component of total stream flow) at ungaged stream sites, 2 different methods were studied and the results were compared. By the first method, base flow was estimated from 6 physical and hydrologic basin characteristics. These 6 characteristics were resolved from regression analyses of about 1,000 combinations of 27 basin characteristics in relation with the base-flow data of 84 long-term streamflow stations in Kansas and adjacent States. The second, and more reliable, method was developed by correlating base-flow current-meter measurements made at the ungaged stream site with data from the records of an established gaging station. Base-flow values estimated by the second method had a smaller standard error than values estimated by the first method in 62% of the comparisons made of the results. (USGS)
W69-04978

THE CONSTRUCTION AND USE OF FLOW-VOLUME CURVES,
Geological Survey, Trenton, N.J.
E. G. Miller.
Geol Surv Res 1967, Prof Pap 575-C, pp C216-C218, 1967. 3 p, 1 fig, 2 ref.

Descriptors: *Streamflow, *Hydrographs, Duration curves, Discharge measurement, Hydrograph analysis.
Identifiers: Flow-volume curves.

Flow-volume curves, dealing with the volume of water flowing in a stream, are similar in form to flow-duration curves and are computed from the same arrays of streamflow discharge records used in computing flow-duration curves. They provide an additional tool for preliminary and general studies of the feasibility of using or storing water for various purposes. (USGS)
W69-04979

CHARACTERISTICS OF SUMMER BASE FLOW OF THE POTOMAC RIVER,
Geological Survey, Washington, D. C.
Ronald L. Hanson.
Geol Surv Res 1967, Prof Pap 575-C, pp C212-C215, 1967. 4 p, 5 fig, 1 ref.

Descriptors: *Base flow, Recession curves, Runoff, Storage, Hydrographs, Regression analysis, Precipitation (Atmospheric).
Identifiers: Potomac River.

A relation defining the rate of depletion of summer base flow during periods of negligible precipitation, and a relation expressing the monthly increase in summer base flow due to precipitation have been defined for a virtually unregulated stream. Testing these relations in a combined form using known values of monthly precipitation gives reasonable estimates of summer base flow for subsequent 1-to 4-month periods. A poor correlation was found to exist between monthly precipitation and corresponding increase in base flow. Consideration of variations in monthly evapotranspiration rates and antecedent ground-water conditions should help to explain much of the scatter in this relation; however, additional ground-water data are needed in the basin before a significant improvement in this relation can be expected. (USGS)
W69-04981

MICROSCOPIC DETERMINATION OF BOUNDARY SHEAR AND SUBLAYER TURBULENCE CHARACTERISTICS IN AN OPEN CHANNEL,
Illinois Univ., Urbana.
For primary bibliographic entry see Field 08B.
W69-05150

HYDRAULIC GEOMETRY OF ILLINOIS STREAMS,
Illinois State Water Survey, Urbana; Illinois Univ., Urbana.
For primary bibliographic entry see Field 08B.
W69-05153

FONTENOT V SMITH (CONTRACT AGREEMENTS AND RIGHTS TO NATURAL FLOW).
For primary bibliographic entry see Field 06E.
W69-05170

CONDIFF V KOPSEIKER (EASEMENT - SURFACE DRAINAGE).
For primary bibliographic entry see Field 06E.
W69-05175

2F. Groundwater

DEVELOPING AN IRRIGATION WATER SUPPLY IN THE COASTAL PLAIN,
Auburn Univ, Ala. Dept. of Agricultural Engineering.
James G. Hendrick, and V. Douglas Browning.
J Soil and Water Conserv, Vol 24, No 1, pp 23-24, Jan-Feb 1969. 2 p.

Descriptors: *Observation wells, *Subsurface investigations, Drilling, Shallow wells, Wellpoints, Alluvium, Aquifers, Pipes, Pumping, Water yield, Specific capacity, Transmissivity.
Identifiers: Pumping tests, Aquifer tests, Test wells, Driven wells.

A simple method is given for exploring and determining the potential yield of shallow alluvial aquifers using driven observation and exploration wells. Sections of 2-in pipe, open at the bottom, are driven into the ground and jetted clean with a portable pump. Wells to be used in pumping tests are developed by placing a smaller diameter screen and casing inside the 2-in. pipe, removing the larger pipe, and surging. Pumping tests are run and analyzed by standard methods. (Knapp-USGS)
W69-04749

BASIC DATA COLLECTION FOR WATER DEVELOPMENT IN EAST PAKISTAN,
East Pakistan Water and Power Development Authority, Dacca. Water Investigation.
For primary bibliographic entry see Field 07A.
W69-04755

A STUDY OF WATER RESOURCES IN THE CANBERRA AREA AND THE QUEANBEYAN RIVER WATERSHED (GOOGONG DAM CATCHMENT),
Northern Illinois Univ., DeKalb. Dept. of Earth Sciences.
For primary bibliographic entry see Field 02E.
W69-04757

SURFACE AND SUBTERRANEAN HYDROLOGY IN ITS APPLICATION TO THE STUDY OF THE MODAVE KARSTIC AQUIFER IN BELGIUM (FRENCH),
Bordeaux Univ., (France).
For primary bibliographic entry see Field 02E.
W69-04762

RATIO METHOD FOR DETERMINING CHARACTERISTICS OF IDEAL, LEAKY, AND BOUNDED AQUIFERS,
Hyderguda, Hyderabad (India).
T. N. Narasimhan.
Bull Int Assoc Sci Hydrol, Vol 13, No 1, pp 70-83, Feb 1968. 14 p, 7 fig, 12 tab, 7 ref.

Descriptors: *Aquifers, *Groundwater, *Leakage, *Bound water, *Mathematical models, Mathematical studies, Aquifer characteristics, Depression, Wells, Discharge, Pumping, Thermal conductivity, Water storage, Storage coefficient, Groundwater movement, Transmissivity.
Identifiers: *Ideal aquifer, Bounded aquifer, Ratio method.

A ratio method is presented which eliminates the use of classical curve-matching techniques for computing the characteristics of ideal, leaky and bounded aquifers. The method is based on application of the Theis non-equilibrium equation and several modifications suggested by Jaeger (1959) Bendochea (1963), and Narasimhan (1966). The method consists of selecting any three values of observed drawdown, (t sub 0, s sub 0), (t sub 1, s sub 1) and (t sub 2, s sub 2), such that t sub 1 = 2 t sub 0 and t sub 2 = 100 t sub 0, where t sub 0, t sub 1, t sub 2, are the pumping times and s sub 0, s sub 1, and s sub 2 are the drawdown of groundwater surfaces. By using the s sub 0/s sub 1 and s sub 0/s sub 2 ratios and extrapolating curves, the aquifer characteristics can be evaluated. Some assumed examples for the demonstration of the use of this ratio method are given. (Gabriel-USGS)
W69-04763

THEORETICAL FRAMEWORK FOR ASCERTAINING PORE WATER PRESSURE IN CONFINING LAYERS IN THE VICINITY OF A PUMPING WELL,
Nevada Univ., Reno. Desert Research Inst.
David V. Anderson.
Water Resources Res Center Proj Rep No 9, July 1968. 8 p, 1 fig, 1 ref. OWRR Project A-016-NEV (1).

Descriptors: *Pore pressure, *Aquicludes, *Drawdown, *Mathematical models, Numerical analysis, Computers, Pumping, Aquifers, Boundaries (Surfaces), Hydraulics, Hydrogeology, Water storage.
Identifiers: Confining bed drawdown, Pore pressure changes.

A mathematical method is described for determining pore water pressure changes in a confining layer overlying an aquifer near a pumping well. A numerical analysis method for solution of the equations is discussed. Much of the analysis was developed by Hantush in his work on the theory of leaky aquifers. The model assumes cylindrical symmetry with a well completely penetrating an aquifer and an overlying semipervious or impervious layer, but not penetrating an underlying impermeable layer. (Knapp-USGS)
W69-04767

INFLUENCE OF THE SOUTH SASKATCHEWAN RESERVOIR (CANADA) ON PIEZOMETRIC LEVELS IN UNDERLYING BEDROCK AQUIFERS,
Department of Energy, Mines and Resources, Calgary (Alberta). Inland Waters Branch.
R. O. Van Everdingen.
J Hydrol, Vol 5, No 4, pp 351-359, Oct 1967. 9 p, 3 fig, 3 tab, 2 ref.

Descriptors: *Reservoirs, *Water level fluctuations, *Aquifers, *Surface-groundwater relationships, Water table, Discharge (Water), Reservoir leakage, Water loss, Seepage.
Identifiers: Saskatchewan, Saskatoon, Saskatchewan River.

Effects of filling of the South Saskatchewan Reservoir on piezometric levels in the three upper bedrock aquifers in the surrounding area are a function of hydraulic connection between the reservoir and the aquifers, and of back-up of potential discharge from still deeper aquifers. Some water is probably being lost from the reservoir into the uppermost bedrock aquifer on the west side of the reservoir. No evidence was found for a loading effect, which would have been indicated by subsequent lowering of piezometric levels due to dissipation of the initial effect. (Knapp-USGS)
W69-04774

GEOLOGY OF THE REGOLITH AQUIFERS OF THE NISHNABOTNA BASIN,
Iowa State Univ., Ames.
Lyle V. A. Sendlein, Donald E. Henkel, and Keith M. Hussey.
OWRR Project A-012-IA. Iowa State Water Resources Res Inst Completion Rep, June 30, 1968. 29 p, 6 fig, 42 ref.

Descriptors: *Hydrologic budget, *River basins, Seismic studies, Electrical studies, Resistivity, Groundwater movement, Geophysics, Alluvium, Glacial drift, Aquifers, Sands, Gravels, Iowa.
Identifiers: Buried glacial valleys, Outwash, Drainage basin analysis.

In the analysis of the water budget of basins, the one variable generally assumed to be constant is groundwater inflow and outflow. This study is the first phase of an investigation designed to evaluate the validity of this assumption in a glacial terrain underlain by a bedrock valley system. With the integrated use of geologic and geophysical data a major bedrock valley was mapped. The valley mapped represents the northern extension of a major buried valley system of Missouri. Sand and gravel deposits were not only found in segments of the buried valley but also as a basal drift unit on the bedrock upland surface. The modern West Nishnabotna roughly overlies the major buried valley whereas the East Nishnabotna River only overlies segments of tributaries of the major valley. Bedrock which subcrops in the basin is Pennsylvanian in the southern half both on the upland and in the buried valley. In the northern portion it is Cretaceous on the uplands and Pennsylvanian in the valleys. The application of the seismic refraction electrical resistivity methods proved valuable and economical. (Knapp-USGS)
W69-04781

WATER RESOURCES APPRAISAL OF THOUSAND SPRINGS VALLEY, ELKO COUNTY, NEVADA,
Geological Survey, Carson City, Nev.
For primary bibliographic entry see Field 02E.
W69-04791

NEW THRUSTS IN GROUND WATER,
Geological Survey, Washington, D. C.
C. L. McGuinness.
Water Well J, Vol 23, No 2, pp 22-24, Feb 1969. 3 p.

Descriptors: *Water resources development, *Groundwater, *Planning, Water utilization, Water supply, Water yield, Water storage, Surface waters, Water wells, Water treatment, Desalination, Recharge, Aquifers, Reservoirs, Injection wells, Waste disposal.

The use of groundwater is increasing in the U.S., and it is expected to continue to increase in the future. From 1950 to 1965, groundwater withdrawals doubled from about 30 to about 60 bgd, while surface water use rose from about 150 to about 250 bgd. The use of aquifers should continue to increase as surface water costs, driven upward by increasing reservoir site and treatment costs, become prohibitive. Aquifers are good storage media in place of dams and reservoirs. Saline aquifers will be considered part of the water resource, while very saline aquifers will be used as storage media for industrial and domestic wastes. Both the techniques and economics of groundwater development must be studied on a much larger scale than is being done now. (Knapp-USGS)
W69-04793

GROUND WATER: PERSPECTIVES AND PROSPECTS,
Geological Survey, Washington, DC.
Raymond L. Nace.
Water Well J, Vol 23, No 2, pp 28-29, Feb 1969. 2 p, 1 fig, 1 tab.

Descriptors: *Water resources development, *Groundwater, Planning, Water management (applied), Water utilization, Water supply, Water yield, Water storage, Water wells, Recharge, Injection wells, Reservoirs, Waste disposal, Vadose water, Runoff, Water control.
Identifiers: Isochronous water volume.

Trends in groundwater and aquifer use are reviewed. About 96% of all continental fresh water is in aquifers. Planning for efficient water use must include underground water storage because the construction and maintenance costs of recharge projects are low, there is no reservoir silting, valuable land surface is not used, no surface flooding of any great extent is used, and evaporation loss is small. Some disadvantages are slow response time, need for pumping, invisibility to planners and the public, lack of recreational or esthetic values, and lack of monumental quality for engineers, planners, and politicians. Planning of groundwater development is necessary to prevent reckless depletion and waste disposal practices. Underground disposal of wastes is not well regulated now but it is increasing rapidly. No organized specifications or criteria exist for evaluating or regulating its impact on water supplies. (Knapp-USGS)
W69-04794

FLUID MECHANICS OF DEEP-WELL DISPOSALS,
DeGolyer and MacNaughton, Dallas, Tex.
For primary bibliographic entry see Field 05E.
W69-04928

SUBSURFACE DISPOSAL OF LIQUID INDUSTRIAL WASTES BY DEEP-WELL INJECTION,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Cincinnati Water Research Lab.
For primary bibliographic entry see Field 05E.
W69-04941

IMPORTANCE OF DEEP PERMEABLE DISPOSAL FORMATIONS IN LOCATION OF A LARGE NUCLEAR-FUEL REPROCESSING PLANT,
Oak Ridge National Lab., Oak Ridge, Tenn. Health Physics Div.
For primary bibliographic entry see Field 05E.
W69-04942

POSSIBILITIES FOR DISPOSAL OF INDUSTRIAL WASTES IN SUBSURFACE ROCKS OF NORTH FLANK OF APPALACHIAN BASIN IN NEW YORK,
Shell Canadian Exploration Co., Houston, Tex.; Tidewater Oil Co., Pittsburgh, Pa.; Consolidated Gas Supply Corp., Clarksburg, W. Va.
For primary bibliographic entry see Field 05E.
W69-04943

POSSIBILITIES FOR SUBSURFACE WASTE DISPOSAL IN A STRUCTURAL SYNCLINE IN PENNSYLVANIA,
Princeton Univ., N. J. Dept. of Geological Engineering; Atomic Energy Commission, Washington, D. C.
For primary bibliographic entry see Field 05E.
W69-04944

GEOLOGY OF SUBSURFACE WASTE DISPOSAL IN MICHIGAN BASIN,
Michigan Univ, Ann Arbor.
For primary bibliographic entry see Field 05E.
W69-04945

SUBSURFACE WASTE-DISPOSAL POTENTIAL IN SALINA BASIN OF KANSAS,
Augustana Coll., Rock Island, Ill.; Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 05E.
W69-04946

POTENTIAL OF DENVER BASIN FOR DISPOSAL OF LIQUID WASTES,
Sun Oil Co., Denver, Colo.; Wolf Exploration Co., Dallas, Tex.
For primary bibliographic entry see Field 05E.
W69-04947

SEDIMENTARY HISTORY AND ECONOMIC GEOLOGY OF SAN JUAN BASIN, NEW MEXICO AND COLORADO,
Montana State Univ., Missoula; El Paso Natural Gas Co., Tex.; Texaco, Inc., Farmington, N. Mex.
For primary bibliographic entry see Field 05E.
W69-04948

ON INVESTIGATIONS CONCERNING THE INFLUENCE OF AGRICULTURAL UTILIZATION ON THE RUNOFF FORMATION BY MEANS OF GROUNDWATER-LYSIMETERS,
Institut fuer Wasserwirtschaft, Berlin (East Germany).
For primary bibliographic entry see Field 02G.
W69-04951

CONTRIBUTION CONCERNING THE FLOW RATES OF RIVERS TRANSPORTING DRAIN WATERS OF OPEN-CAST MINES,
Wasserwirtschaftsdirektion, Cottbus (East Germany).
For primary bibliographic entry see Field 04C.
W69-04956

IMMOBILITY OF CONNATE WATER IN PERMEABLE SANDSTONE,
Geological Survey, Washington, D. C.; Bureau of Mines, Morgantown, W. VA., Petroleum Research Lab.
G. Edward Manger, and W. T. Wertman.
Geol Surv Res 1967, Prof Pap 575-C, pp C192-C194, 1967. 3 p, 1 tab, 3 ref.

Descriptors: *Connate water, *Sandstones, *Permeability, Texas, Unsaturated flow, Diffusion, Saturated flow, Porous media.
Identifiers: Immobile connate water.

Some natural-state cores of moderately permeable Eocene sandstone, obtained by drilling with oil-base mud in Karnes County, Tex., appear to be saturated and other cores appear to be partially unsaturated. The variation of interstitial water chlorinity is related to the depositional environment of the different sandstone strata. These results suggest that a small fraction of connate water has remained immobile in the sandstone since the Eocene. Such immobility agrees with that found experimentally by Wyckoff and Botset and discussed theoretically by Irmay for a small fraction of fluid in a saturated permeable porous medium. Absence of significant diffusion over geologic ages seems to be necessary to explain the present results; reasons for this are not yet evident. (USGS)
W69-04977

HYDROGEOLOGIC SIGNIFICANCE OF CALCIUM-MAGNESIUM RATIOS IN GROUND WATER FROM CARBONATE ROCKS IN THE LANCASTER QUADRANGLE, SOUTHEASTERN PENNSYLVANIA,
Geological Survey, Harrisburg, Pa.
Harold Meisler, and Albert E. Becher.
Geol Surv Res 1967, Prof Pap 575-C, pp C232-C235, 1967. 4 p, 3 fig, 1 tab, 3 ref.

Descriptors: *Water chemistry, *Limestones, *Dolomite, *Carbonate rocks, Geologic mapping, Calcium, Magnesium, Hydrogeology.
Identifiers: Calcium-magnesium ratios, Carbonate rock mapping.

The ratios in equivalents of calcium to magnesium in groundwater from the limestones and dolomites of the Lancaster quadrangle in southeastern Pennsylvania correlate well with the composition of the carbonate source rocks. The lowest calcium-magnesium ratios occur in water from dolomite; the ratios are very close to the stoichiometric proportion of calcium to magnesium in the mineral dolomite. The highest calcium-magnesium ratios are in water from limestone. In groundwater from interbedded limestone and dolomite, the calcium-magnesium ratios are between those in water from dolomite. When applied with caution, calcium-magnesium ratios in groundwater can be an aid to geologic mapping of a limestone and dolomite terrane. (USGS)
W69-04985

MEASUREMENT OF THE ABUNDANCE OF FRACTURE TRACES ON AERIAL PHOTOGRAPHS,
Geological Survey, Washington, D. C.
F. W. Trainer.
Geol Surv Res 1967, Prof Pap 575-C, pp C184-C188, 1967. 5 p, 3 fig, 14 ref.

Descriptors: *Fractures (Geology), *Aerial photographs, Remote sensing, Methodology, Carbonate rocks, Porosity, Mapping, Water wells.
Identifiers: *Fracture traces, Discovery-time curve.

An objective method is illustrated of investigating the areal abundance of fracture traces seen on aerial photographs. The report discusses several factors to be considered in a standardized technique based on a study in a 10 sq mi area near Front Royal, Va. A uniform duration of search, in time per unit area, assures consistent results; and rate of discovery of fracture traces decreases logarithmically with time. The probably total number of traces per unit can be estimated from the straightest part of the discovery-time curve. Contour maps based on such index numbers show areal distribution of abundance. Fracture traces can be mapped as indices of fracture porosity. The abundance of traces may be proportional to the total number of open fractures. Extensive surface weathering accompanied by subsurface weathering and fracture-trace intersections may indicate areas of higher specific capacity in water wells on or near the traces. (Lang-USGS)
W69-04987

FACTORS AFFECTING BIOLOGICAL CLOGGING OF SAND ASSOCIATED WITH GROUND WATER RECHARGE,
Weizmann Inst. of Science, Rehovoth (Israel).
For primary bibliographic entry see Field 03C.
W69-05075

FURTHER STUDY OF AQUIFER PERFORMANCE,
Illinois Univ., Urbana.
For primary bibliographic entry see Field 02A.
W69-05149

2G. Water in Soils

A CLIMATOLOGICAL-TECHNOLOGICAL METHOD FOR ESTIMATING IRRIGATION WATER REQUIREMENTS FOR MAXIMUM CROP YIELDS,
Illinois State Water Survey, Urbana.
For primary bibliographic entry see Field 03F.
W69-04750

WATER HOLDING CAPACITY OF PONDEROSA PINE FOREST FLOOR LAYERS,
Forest Service (USDA), Flagstaff, Ariz. Rocky Mountain Forest and Range Experiment Station.
For primary bibliographic entry see Field 03B.
W69-04751

THERMAL CONDUCTIVITY OF TWO-PHASE POROUS MATERIALS: DRY SOILS,
Rajasthan Univ., Jaipur (India). Dept. of Physics.
For primary bibliographic entry see Field 07B.
W69-04949

ON INVESTIGATIONS CONCERNING THE INFLUENCE OF AGRICULTURAL UTILIZATION ON THE RUNOFF FORMATION BY MEANS OF GROUNDWATER-LYSIMETERS,
Institut fuer Wasserwirtschaft, Berlin (East Germany).
Dietrich Kramer, and Hermann Taeger.
Int Ass Sci Hydrol Pub No 76, Symp on Hydrol Aspects of Util of Water, Bern, Sept 25-Oct 7, 1967, pp 123-133, 1968. 11 p, 2 fig, 6 tab, 19 ref.

Descriptors: *Lysimeters, *Evaportanspiration, *Rainfall-runoff relationships, Farm management, Catch crops, Crop response, Cultivation, Demonstration farms, Demonstration watersheds, Fallowing.
Identifiers: Germany, Groundwater lysimeters, Crop rotation.

Lysimeter studies of the effect of agricultural practices on the rainfall-runoff relationships were made in Germany. A system of 28 groundwater lysimeters was set up as 14 pairs in fallow, rotation-crop, and pasture lands. The water table fluctuates seasonally between 20 and 150 cm below the land surface. Soil and climatic data are tabulated. Cultivation was found to diminish runoff compared to fallow, with the larger differences in the growth periods of plants. Runoff is increased by intensification of pasture-land fertilization and mowing. Catch crop cultivation caused a diminished runoff of 49 mm for the year 1966. (Knapp-USGS)
W69-04951

PROPERTIES OF SALINE RANGE SOILS OF THE RIO GRANDE PLAIN,
Agricultural Research Service, Weslaco, Tex. Soil and Water Conservation Research Div.; Soil Conservation Service, Harlingen, Tex.; Soil Conservation Service, Alice, Tex.
C. D. Fanning, C. M. Thompson, and Dean Issacs.

J. Range Management, Vol 18, No 4, pp 190-193, July 1965. 3 fig, 2 tab.

Descriptors: *Soil properties, *Ranges, *Saline soils, *Revegetation, *Vegetation regrowth, Texas, Range management, Desert plants, Grazing, Range grasses, Ecology, Rainfall, Soil chemical properties, Soil physical properties, Salts, Soil-water-plant relationships.
Identifiers: Reseeding, Rio Grande Plain, Texas.

This study was an evaluation of properties common to three saline soils in the Rio Grande Plain and provided basic chemical and physical data for consideration in obtaining solutions to problems related to their ecology and management. Range conditions on the saline soils were poor as a result of overgrazing. On saline soils reseeding attempts were discouraging. The successful establishment of grass was primarily dependent on timely rainfall. Soil properties suggested that proper vegetative cover would enhance salt removal. Reseeding efforts would need to take into consideration proper species selections and drought-inducing effects of the excess salts that occur in an arid area of Texas. (Blecker-Arizona)
W69-05084

TILLAGE INFLUENCES WATER INTAKE,
Agricultural Research Service, Morris, Minn. North Central Soil Conservation Research Center;

Southwest Minnesota Agricultural Experiment Station, Lamberton.
R. E. Burwell, L. L. Sloneker and W. W. Nelson.
J. of Soil and Water Conservation, Vol 23, No 5, pp 185-187, September-October 1968. 3 tab, 9 ref.

Descriptors: *Cultivation, *Soil surfaces, *Infiltration, *Runoff, *Weathering, Soil treatment, Loam, Clay loam, Soil texture, Soil erosion, Soil moisture, Mulching, Water storage, Artificial precipitation.
Identifiers: *Roughness (Soil), Sealing.

The studies were conducted to determine the influence of different tillage methods on soil surface condition and subsequent infiltration. Artificial rainfall was applied at the rate of 5 inches per hour to various surface conditions on loam, clay loam and sandy clay loam. Surface conditions were created by moldboard plowing, moldboard plowing-disking-harrowing, rotary tillage and mulch tillage. Infiltration before runoff started on freshly-tilled bare surfaces increased as tillage-induced random roughness increased. Infiltration was not closely related to this roughness after rainfall or fall-to-spring weathering caused surface seal development. Infiltration before runoff began was twice as high on freshly plowed surfaces as on freshly plowed-disked-harrowed surfaces. Fall mulch-tilled surfaces provided eight times greater infiltration capacity before runoff started and four times greater infiltration during runoff the following spring than did fall plowed surfaces which were disked and harrowed in the spring. The tillage-infiltration relationships that were studied could possibly be used to increase infiltration and reduce the runoff from arid soils. (Blecker-Arizona)
W69-05089

CAPILLARY CONDUCTIVITY AND SOIL WATER DIFFUSIVITY VALUES FROM VERTICAL COLUMNS,
California Univ., Davis.
W. J. Flocker, M. Yamaguchi, and D. R. Nielsen.
Agronomy J, Vol 60, No 6, pp 605-10, Nov-Dec 1968. 5 fig, 21 ref, append.

Descriptors: *Evaporation, *Darcys law, *Soil water movement, *Capillary conductivity, *Diffusivity, Air temperature, Loam, Gamma rays, Soil water, Density, Moisture content, Electrical conductance, Saline soils, Depth, Equations, Moisture tension, Water loss, Soil physics.
Identifiers: *Soil columns.

Water evaporated from vertical columns of Yolo loam, 100 cm long, for 200 days at ambient temperatures of 10, 20, and 30 degrees C. plus or minus 1 degree C. Changes in soil water were monitored at 5 cm. depth intervals by gamma-ray attenuation. Water movement within the soil columns was analyzed using Darcy's law. Water contents decreased monotonically at each soil depth. For the three ambient temperatures, soil water characteristics curves were similar except at soil water tensions less than 75 cm where colder samples retained more water. For any measured water content, values of capillary conductivity increased with ambient temperature. Electrical conductivity measurements made on soil extracts taken at the conclusion of the experiment indicated a slight but significant salinity gradient over soil depths for which calculations of capillary conductivity were made. Capillary conductivity and soil water diffusivity values for arid soils could be determined using procedures and methods discussed in the paper. (Blecker-Ariz)
W69-05093

PROPERTIES OF SOIL UNDER ASPEN AND HERB-SHRUB COVER,
Forest Service (USDA), Logan Utah. Intermountain Forest and Range Experiment Station.
Ronald K. Tew.
U.S.D.A. Forest Serv. Res. Note INT-78, 1968, 4 pp.

Descriptors: *Soil chemical properties, *Soil physical properties, *Soil-water-plant relationship, *Sagebrush, Rabbit-brush, Soil environment, Soil analysis, Correlation analysis, Soil types, Nitrates, Phosphorus, Fertility, Sites.
Identifiers: *Herb-shrub cover, Vegetative density.

Several physical and chemical soil properties were measured and related to site aspect and vegetation type. Soil texture, aggregation, organic matter content, nitrate production, and moisture-holding characteristics varied between aspects. Soils under aspen stands have higher organic matter content, with accompanying higher moisture-holding capacity, than do soils on adjacent herb-shrub sites.
W69-05097

FIELD CORRELATION OF TWO NEUTRON-SCATTERING SOIL MOISTURE METERS,
Forest Service (USDA), Logan, Utah. Intermountain Forest and Range Experiment Station.
For primary bibliographic entry see Field 07B.
W69-05100

THE INFLUENCE OF GROWTH MEDIA, TEMPERATURES, AND LIGHT INTENSITIES ON ASPEN ROOT AND TOP GROWTH,
Forest Service, (USDA), Logan, Utah. Intermountain Forest and Range Experiment Station.
Gerald F. Gifford.
U.S.D.A. Forest Serv. Res. Note INT-67, 1967, 4 pp.

Descriptors: *Root development, *Root systems, *Soil properties, *Soil types, Light intensity, Air temperature, Vegetation regrowth, Environmental effects, Nutrient requirements, Moisture availability, Growth chamber, Potassium, Nitrogen, Phosphorus, Ecological distribution, Clay loam, Elevation, Plant growth regulators, Photosynthesis.
Identifiers: *Growth media, Root inhibition, *Populus species.

Root and top growth of aspen cuttings in three soils (sand, loam, and clay) were studied in a controlled environmental chamber. The cuttings were exposed to two light intensities (2,000 ft.-c. and 600 ft.-c.) for 50 days at each of three temperatures (10 deg., 18 deg., and 27 deg. C.). Root growth in loam soil was favored when plants were grown at 18 deg. C. but at 27 deg. C. the top growth was erratic and root growth was small. At all temperatures and light intensities, the plants growing in sand and clay produced smaller yields of roots and less top growth than did those growing in loam. Light intensity significantly influenced root growth only in loam soil at 18 deg. C. Top growth was not significantly influenced by light intensity at all three temperatures.
W69-05101

EVAPOTRANSPIRATION AND SOIL-MOISTURE DEPLETION,
Forest Service (USDA), Moscow, Idaho. Intermountain Forest and Range Experiment Station.
Edward R. Burroughs, Jr., and John D. Schultz.
Proceedings, Society of American Foresters, Denver, Colorado, 1964, 4 pp.

Descriptors: *Hydrologic cycle, *Evapotranspiration, *Water yield improvement, *Nuclear moisture meters, Water measurement, Soil moisture, Water storage, Seepage, Throughfall, Stemflow, Gravimetric analysis, Lysimeters, Seismic studies, Resistivity, Geophysics, Percolation, Soil physics, Geologic formations.

The methods used to evaluate evapotranspiration by measuring the depletion of soil moisture are discussed, the problems encountered in obtaining reliable data and interpreting results are pointed out, and some suggestions for getting better results are made. Two major problems exist in many field installations; (1) separation of deep seepage loss from evapotranspiration, and (2) edaphic heterogeneity of the study site. A mathematical method of separating seepage from evapotranspiration is discussed, and a possible field test procedure is given. Edaphic and geologic heterogeneity of study sites may be minimized by use of seismic and electrical resistivity equipment. The most common method of measuring soil moisture content, the neutron-scatter method, possesses some inherent problems, too. Hints are given for easier and better installation of access tubes, especially in rocky soils, and suggestions are made for better service from soil moisture probes.
W69-05102

SOIL MOISTURE DEPLETION BY ASPEN IN CENTRAL UTAH,
Forest Service (USDA), Logan, Utah. Intermountain Forest and Range Experiment Station.
Ronald K. Tew.
U.S.D.A. Forest Serv. Res. Note INT-73, 1967, 8 pp.

Descriptors: *Soil moisture, *Vegetation effects, *Evapotranspiration, Vegetation regrowth, Soil-water-plant relationship, Water yield, Sites, Elevation, Soil analysis, Root systems, Soil profiles, Range management, Wildlife management, Soil moisture meters, Nuclear meters.
Identifiers: *Populus species, Seasonal fluctuations.

Aspect and elevation of site and age of vegetation affect the amount of soil moisture depleted by aspen (Populus tremuloides Michx.) during the growing season in central Utah. Clones on west aspects used more soil moisture than those on either north- or south-facing slopes. Differences in elevation had little effect on the amount of soil moisture depleted by mature aspen, but sprout stands used significantly greater amounts of soil moisture on the lower elevation sites. As much as 5 inches of moisture was conserved in the upper 6 feet of soil during the first season after aspen removal, but as sprout stands became reestablished, there was a decrease in these moisture savings.
W69-05106

SOIL MOISTURE DEPLETION BY GAMBEL OAK IN CENTRAL UTAH,
Forest Service (USDA), Logan, Utah. Intermountain Forest and Range Experiment Station.
Ronald K. Tew.
U.S.D.A. Forest Serv. Res. Note INT-74, 1967, 8 pp.

Descriptors: *Soil moisture withdrawal, *Evapotranspiration, *Sites, *Elevation, Vegetation effect, Soil moisture, Vegetation regrowth, Period of growth, Water holding capacity, Soil physical properties, Soil-water-plant relationship, Soil profiles, Root systems, Water yield improvement, Soil moisture meters, Nuclear meters.
Identifiers: *Quercus.

Aspect and elevation of site and age of vegetation affect the amount of soil moisture depleted by Gambel oak (Quercus gambelii Nutt.) during the growing season in central Utah. More soil moisture was lost at the higher elevation (7,900 feet) than at the lower (6,600 feet) on all aspects. A south-facing site at the higher elevation lost the most moisture, whereas one at the lower elevation lost the least. Most available soil moisture was depleted to a depth of 6 feet on all sites during seasons of normal rainfall. Removing oak and allowing regrowth of a vigorous sprout stand reduced soil moisture depletion nearly an inch during the year following cutting, but by the end of the third year, sprout stands were using up to an inch more soil moisture than mature stands.
W69-05107

SOIL MOISTURE DEPLETION BY GAMBEL OAK IN NORTHERN UTAH,
Forest Service, (USDA), Logan, Utah. Intermountain Forest and Range Experiment Station.
Ronald K. Tew.

U.S.D.A. Forest Serv. Res. Note INT-54, 1966, 7 pp.

Descriptors: *Soil moisture, *Evapotranspiration, *Soil profile, *Soil-water-plant relationship, Rainfall intensity, Soil physical properties, Ground water, Water yield management, Root systems, Overland flow, Environmental effect, Soil moisture meters, Nuclear meters.
Identifiers: *Quercus.

In years of normal rainfall, 11 to 13 inches of moisture are extracted by Gambel oak from the upper 8 feet of soil during the growing season. The total evapotranspirational loss ranges from 15 to 19 inches, depleting moisture from the entire profile. Early season moisture depletion occurs mainly in the upper 4 feet of soil with losses occurring lower in the profile later in the season. Winter precipitation usually provides sufficient moisture to fully recharge the soil profile after the growing season.
W69-05108

CHARACTERIZATION OF THE RATE OF WATER INFILTRATION INTO SOIL,
Purdue Univ., Lafayette, Ind.
D. Swartzendruber, R. W. Skaggs, and D. Wiersma.

Purdue University Water Resources Research Center, Technical Report No. 5, Dec 1968. 120 pp, 39 fig, 13 tab, 37 ref. OWRR Project A-004-IND.

Descriptors: *Infiltration, Soil water movement, Unsaturated flow, *Infiltrometers, *Surface sealing, Cores, Rainfall simulators, *Overland flow, Bulk density, Porous media, Darcy's law, Soil physics, Agricultural engineering.
Identifiers: Infiltration equations, Stratified porous media.

Rate of water infiltration was measured for surface-ponded sand-silt columns and field cores in the laboratory, for small field plots (1.16 by 1.16 m) by a sprinkler infiltrometer, and for larger field plots (12 by 35 ft) by a rainfall simulator. Results were assessed by the theoretically based Green-Ampt and Philip equations, and the empirical Horton and Holtan equations. For the sand-silt columns, the approximate theory of the Green-Ampt equation worked well for uniform conditions at different initial water contents, and for initially air-dry coarse-over-fine stratifications, but not as well for fine-over-coarse stratifications. Some difficulty also was encountered in describing field-core rates, which generally compared more closely with small-plot sprinkler-determined rates when the soil surface was unprotected from sprinkler-drop impact. This suggests the possibility of a partial core-surface seal, perhaps somehow caused by the core-sampling process. Large-plot rainfall-simulator infiltration rates for 13 soils, determined by correcting for surface storage rates with an overland flow analysis, could be reasonably well described by any of the four equations, but the two empirical ones were somewhat better than the two theoretically based ones.
W69-05143

2H. Lakes

WIND-DRIVEN SUMMER CIRCULATION IN THE GREAT LAKES,
Waterloo Univ. (Ontario).
G. T. Csanady.
Grant WP-01139-01 (FWPCA), Grant A-1347 (NRC). J Geophys Res, Vol 73, No 8, pp 2579-2589, Apr 15, 1969. 11 p, 3 fig, 9 ref.

Descriptors: *Currents (water), *Water circulation, *Great Lakes, Winds, Thermocline, Model studies, Mathematical models, Kinetics, Energy.
Identifiers: Frictionless circulation model.

Simplified models of wind-forced motions are considered in the two-layer circular basin 'model Great Lake'. Under summer conditions, when a thermocline is present, both a uniform, steady wind and a uniform wind varying periodically in time produce a frictionless lake response characterized by strong boundary currents and pronounced thermocline movements in the shore zone. The length scale determining the width of this shore zone is the 'radius of deformation', typically three miles. Observations on Lakes Huron, Michigan, and Ontario show such motions to be present near the shores. (Knapp-USGS)
W69-04789

DISTRIBUTION, ENVIRONMENTAL REQUIREMENTS AND SIGNIFICANCE OF CLADOPHORA IN THE GREAT LAKES,
Ontario Water Resources Commission, Toronto, Biology Branch.
John H. Neil, and Glenn E. Owen.
Publication Number 11, Great Lakes Res Div, Michigan Univ, pp 113-121, 1964. 4 fig, 2 tab, 2 ref.

Descriptors: *Algae, *Algal control, *Essential nutrients, *Eutrophication, *Cladophora, *Nuisance algae, *Sewage, Algicides, Aquatic algae, Aquatic productivity, Bioassay, Cycling nutrients, Environmental effects, Harvesting algae, Inhibition, Light penetration, Limnology, Nitrogen compounds, Nutrient requirements, Nutrients, Phosphorus compounds, Physiological ecology, Pollution identification, Sewage disposal, Water pollution, Water pollution control, Water pollution effects, Water pollution sources.

Excessive growths of Cladophora sp along certain sections of the Great Lakes shoreline create serious nuisance conditions which affect the use of water for recreational, industrial, and municipal purposes. Information on the ecology of this algae was collected as part of a study directed toward the development of control measures. The presence of Cladophora sp is dependent on a suitable substrate for attachment, water movement, adequate light, and nutrients in excess of those normally available in the waters of the upper Great Lakes. Lakes Ontario and Erie have sufficient inherent fertility to support marginal growths, but, where local nutrient sources are available, production increases. Application of phosphorus to a location providing suitable physical conditions but devoid of Cladophora sp resulted in the establishment of a sizeable area of growth. The results of attempts at control are also discussed. (Fitzgerald-Wis)
W69-04798

CALORIFIC VALUES OF SOME INVERTEBRATES IN LAKE MENDOTA, WISCONSIN,
Wisconsin Univ., Madison. Lab. of Limnology.
Thomas E. Wissing, and Arthur D. Hasler.
J Fish Res Board Can, Vol 25, No 11, pp 2515-2518, 1968. 2 tab, 6 ref.

Descriptors: *Invertebrates, *Energy budget, Analytical techniques, Crustaceans, Daphnia, Ecosystems, Energy, Eutrophication, Growth stages, Insects, Lakes, Limnology, Mayflies, Midges, Wisconsin.
Identifiers: *Calorific content, *Energy flow, *Lake Mendota, Wis, Calorimetry, Glyptotendipes, Caenis, Chitin, Leptodora kindii, Hyalella azteca.

Analysis of energy flow through aquatic ecosystems requires calorific equivalents of their biotic components. In this paper, authors contribute data on calorific content of aquatic organisms derived from 53 determinations on 33 collections comprising 8 types of insect and crustacean material from eutrophic Lake Mendota, Wisconsin. Oven-dried materials (60 deg C, 24 hours) were burned in a Phillipson microbomb calorimeter. Results are expressed as calories/gram of ash-free weight (units are almost certainly gram calories although report does not so specify). Ranges of mean values determined for various collections (numbers of determinations, N, indicated in parentheses) are: midge Glyptotendipes sp laryae (9), 4979-5752; midge Glyptotendipes sp pupae (1), 5023; mayfly nymph Caenis sp (2), 6985-7130; Daphnia spp (13), 4132-6071; female Daphnia spp. with eggs (5), 3776-5652; daphnid chitin (2), 5753; Leptodora kindii (16), 4305-5169; Hyalella azteca (5), 3819-4079. Tabulation in report includes data pertaining to percentage ash, numbers, weights of organisms burned, and ranges for individual determinations when N exceeds 2. Authors present no estimates of accuracy and precision of measurements. They state that further studies of seasonal variation in calorific content of species and larval instars are underway. (Eichhorn-Wis)
W69-04799

ON THE MECHANISM OF LANGMUIR CIRCULATIONS AND THEIR ROLE IN EPILIMNION MIXING,
State Univ. of New York, Albany. Atmospheric Sciences Research Center.
Jon T. Scott, Glenn E. Myer, Ronald Stewart, and Eric G. Walther.
Final Rep No 3-The Role of Langmuir Circulation in Mixing of Lake George. Atmos Sci Res Center Pub No 61, pp 1-18, Aug 1968. 18 p, 11 fig, 24 ref. OWRR Project B-008-NY (5).

Descriptors: *Currents (Water), *Lakes, *Vortices, Eddies, Winds, Waves (Water), Water temperature, Water circulation, Turbulence, Mixing, Limnology, New York, Epilimnion, Thermal stratification.
Identifiers: Lake George (NY), Langmuir circulation, Upwelling currents, Ekman drift, Vertical circulation.

Six mechanisms have so far been proposed for explaining vertical or Langmuir circulations and their associated wind streaks. One mechanism involving shearing instability and 2 requiring the action of a surface film are supported by the greatest amount of evidence. Studies at Lake George, N. Y. suggest that more than 1 mechanism may operate at 1 location. A particular mechanism may operate at a specific site because of typical conditions at that site, but a different mechanism may be more important at another site. Plots of thermal structure in the near surface layer of Lake George and measurements of vertical current velocities suggest that Langmuir circulations are the most important mixing process in the epilimnia of lakes.
W69-04929

WAVE INTERACTION AND LANGMUIR CIRCULATIONS,
State Univ. of New York, Albany. Atmospheric Sciences Research Center.
Ronald Stewart, and Richard K. Schmitt.
Final Rep No 3-The Role of Langmuir Circulation in Mixing of Lake George. Atmos Sci Res Center Pub 61, pp 42-47, Aug 1968. 6 p, 2 fig, 14 ref. OWRR Project B-008-NY (5).

Descriptors: *Waves (Water), *Lakes, Numerical analysis, Winds, Water circulation, Turbulence, Mixing, New York.
Identifiers: Water wave interactions, Wind streaks, Langmuir circulation, Lake George (NY).

The interaction of 2 trochoidal wave trains is examined numerically to compare the computed wave shapes and locations to the observation of streaking associated with Langmuir circulations. The wave trains approach each other at an angle of $0 = 15$ deg, 20 deg, and 25 deg. The resulting areas of maximum amplitude form apparent streaks and move across the field of vision, similar to the motion of streaks associated with Langmuir circulations. Lateral motion of whitecap areas was observed as the normal movement of wind streaks.
W69-04930

THERMAL STRUCTURE AND VERTICAL HEAT TRANSPORT IN LANGMUIR CIRCULATIONS,
State Univ. of New York, Albany. Atmospheric Sciences Research Center.
Glenn E. Myer.

Final Rep No 3-The Role of Langmuir Circulation in Mixing of Lake George. Atmos Sci Res Center Pub No 61, pp 19-41, Aug 1968. 23 p, 19 fig, 4 tab, 12 ref. OWRR Project B-008-NY (5).

Descriptors: *Currents (Water), *Lakes, *Vortices, Instrumentation, Eddies, Winds, Waves (Water), Water temperature, Water circulation, Turbulence, Mixing, Limnology, Regression analysis, New York, Thermal stratification, Thermocline, Epilimnion.
Identifiers: Lake George (NY), Langmuir circulation, Upwelling currents, Ekman drift, Vertical circulation.

The results of a study to determine thermal structure associated with streaks and the role of Langmuir circulations in epilimnion mixing are reported. A floating instrument probe was constructed to obtain data on Lake George from August 1967 through December 1967. The thermal structures of Langmuir circulations under stable and unstable conditions were obtained. Autocorrelations of water temperature were computed and indicated that there was a scale of turbulence associated with streaking conditions much larger than that of ordinary turbulence. Thermal effects in the air implied an organization to the air flow over streaks. From this study it was found that Langmuir circulations are a major cause of epilimnion mixing and thermocline formation and movement in summer and autumn.
W69-04931

WATER POLLUTION BY OUTBOARD MOTORS,
State Univ. of New York, Albany. Atmospheric Sciences Research Center.
Ronald Stewart, and H. H. Howard.
Final Rep No 3-The Role of Langmuir Circulation in Mixing of Lake George. Atmos Sci Res Center Pub No 61, pp 48-52, Aug 1968. 5 p, 13 ref. Grant 14-01-0001-1036. OWRR Project B-008-NY (5).

Descriptors: *Water pollution sources, *Lakes, *Boats, Fuels, Oil wastes, New York, Oily water, Phenols, Cooling water, Taste, Odor.
Identifiers: Lake George (NY), Outboard motor wastes.

Pollution of water by outboard motor oil and fuel discharges is reviewed, and the amount of oil contributed to Lake George, New York, by outboard motors is calculated. Outboard fuel and oil sales average about 400,000 gal per year of which 10% is discharged to the water in the southern end of the lake. It is calculated that 1 part total fuel consumed to 1 million parts lake water is enough to raise the threshold odor level. Fuel sales are tripling about every 8 yr. The problem will become severe if ignored. Oil and fuel wastes increase BOD and turbidity and will seriously degrade the esthetic quality of the lake. (Knapp-USGS)
W69-04936

HYDROLOGIC BASES OF WATER RESOURCES UTILIZATION OF LAKES,
Research Inst. for Water Resources Development, Budapest (Hungary).
K. Szesztay.
Int Ass Sci Hydrol Pub No 76, Symp on Hydrol Aspects of Util of Water, Bern, Sept 25-Oct 7, 1967, pp 187-196, 1968. 10 p, 7 fig, 2 tab, 4 ref.

Descriptors: *Lakes, *Storage, *Streamflow, *Water utilization, Streamflow forecasting, Hydrologic budget, Analog models, Digital computers.
Identifiers: Hungary, Finland.

Long-term meteorologic and hydrologic forecasts are necessary for regional use of lake water resources. The water in lakes can be regarded as composed of static (stored volume) and dynamic (streamflow) components. Depletion of static resources lowers lake levels, while use of dynamic resources reduces natural outflow. Both must be inventoried before beneficial use is developed. Inventory by study of all individual lakes and ponds is difficult in regional surveys, so regional water budget methods and analysis of regional lake geomorphology to give volume-area relations are used. Studies of the lakes of Finland and Hungary are given as examples. Analog models and digital computer methods aid in evaluation of economic alternatives of water use on a regional scale. (Knapp-USGS)
W69-04957

1967: AN EXCEPTIONAL YEAR IN THE LIFE OF THE DE BERRE POND (FRENCH),
Centre National de la Recherche Scientifique, Marseille (France). General Biology and Ecology Lab.; EDF Hydraulic Group of South-Alps Region.
For primary bibliographic entry see Field 05C.
W69-04958

WATER BALANCE OF LAKE AFFECTED BY SEA (FRENCH),
State Inst. of Hydrology and Meteorology, Warsaw (Poland).
Zdzislaw Mikulski, and Maria Bojanowicz.
Int Ass Sci Hydrol Pub No 76, Symp on Hydrol Aspects of Util of Water, Bern, Sept 25-Oct 7, 1967, pp 197-203, 1968. 7 p, 3 fig, 1 tab, 9 ref.

Descriptors: *Hydrologic budget, *Lakes, *Bays, *Deltas, Inflow, Evaporation, Discharge (Water), Sea water, Precipitation (Atmospheric), Floods, Tides.
Identifiers: Vistula River, Lake Druzno.

The water budget of coastal lakes which are fed by streams and also affected by sea water is estimated, and Lake Druzno in the delta of the Vistula River is used as an illustration. Before computing the water balance of the lake, the exchange of water between the sea and lake was determined. Precipitation, marine water inflow, discharge from the lake, and evaporation were calculated. Stream water inflow to the lake was 2/3 - 3/4 of the lake's total input, and sea water inflow was also significant and rapid enough to be turbulent and affect local flooding conditions. (Knapp-USGS)
W69-04960

EQUILIBRIUM MODELS AND COMPOSITION OF THE GREAT LAKES,
Syracuse Univ., N. Y. Dept. of Geology.
For primary bibliographic entry see Field 02K.
W69-04970

SHORELINE FEATURES AS INDICATORS OF HIGH LAKE LEVELS,
Geological Survey, Ocala, Fla.
Darwin D. Knochenmus.
Geol Surv Res 1967, Prof Pap 575-C, pp C236-C241, 1967. 6 p, 6 fig, 1 tab, 3 ref.

Descriptors: *Lakes, *Lake shores, *Shore-line cover, Trees, Beaches, Water levels, Water level fluctuations, Florida.
Identifiers: Lakeshore tree line, Lake level indicators.

A relation between certain shoreline features (tree line of the slash pine, beach scarp, beach ridge) and high lake levels was found on 8 Florida lakes. For the lakes studied, the features were above the lake level an average of 95% of the time. An estimate of former high levels of ungaged lakes can be made from this relation. Grain-size analyses of the material comprising the various geomorphic features show a consistent relation between median diameter and the type of feature. In order of decreasing median grain size, material of the high beach ridge is followed by that of the low beach ridge, the upland, and the base of the beach scarp. This relation helps separate areas which have been under the influence of wave action from those which have been above the water level. (USGS)
W69-04984

'ANOMALOUS' THERMAL CONDITIONS IN A HYPERSALINE INLAND POND,
Arizona State Univ., Tempe.
Gerald A. Cole, and W. L. Minckley.
Jour of the Ariz Academy of Sci, Vol 5, No 2, pp 105-107, Oct 1968. 1 fig.

Descriptors: *Saline water, *Ponds, *Water temperature, *Thermocline, Density, Arid lands, Mexico, Gravity, Solar radiation, Surface waters, Thermodynamics, Water chemistry, Temperature.

In saline water of arid regions and elsewhere, anomalous temperature profiles are common and result in part by dissolved substances imparting density, and being more important than temperature in this respect. This paper describes some unique temperature gradients in a saline Mexican pool, and presents data on density relations that prevailed. The surface temperature was 24.0 deg C and at 46 cm the temperature was 47.0 deg C. The surface water had a specific gravity of 1.01 at 24.0 deg C and bottom water was at 1.075 at 47 deg C. The high temperature in the deeper water was explained by direct solar radiation penetrating the upper layer. The dense saline bottom water accumulated heat while the dilute upper stratum reduced outgoing radiation and prevented evaporation from it. The contrasting density prohibited mixing of the two layers. (Affleck-Arizona)
W69-05078

OBSERVATIONS ON THE FORMATION AND BREAKDOWN OF THE OXIDIZED MICROZONE AT THE MUD SURFACE IN LAKES,
Freshwater Biological Association, Ambleside (England).
Eville Gorham.
Limnol Oceanogr, Vol 3, pp 291-298, 1958. 2 fig, 9 ref.

Descriptors: *Lakes, *Mud-water interfaces, Turbulence, Lake morphometry, Oxygen, Aerobic conditions, Anaerobic conditions, Aquatic environments, Limnology, Diatoms, Oxidation reduction potential, Algae, Tubificids.
Identifiers: Esthwaite Water, English Lake District, Iron compounds, Melosira italica.

The theory is presented that the oxidized microzone at the mud-water interface is due to turbulent mixing of mud into the oxygen-richer water, followed by resettling. Its thickness varies with time of year and the reducing activity of the underlying mud. In Esthwaite Water and others of the English Lake District the zone is sharply defined by orange-brown caused by ferric compounds, overlying blacker mud caused by ferrous sulfide deposition. Evidence for the turbulence theory: formation after the fall overturn; presence of algal colonies and tubificid worm tracks; lighter density; sharp differences in electrical conductivity and redox potential; and correlation with life cycle of Melosira italica subarctica. This theory is a challenge to Mortimer's previous explanation of the zone as reflecting downward diffusion of oxygen from the water to surface mud meeting a barrier in the reducing power of the underlying mud. (McCoy-Wisconsin)
W69-05139

SEASONAL VARIATION IN CONTENT OF NITROGENOUS COMPOUNDS AND PHOSPHATE IN THE WATER OF TAKASUKA POND, SAITAMA, JAPAN,
Tokyo Imperial Univ. (Japan). Geographical Inst.
S. Yoshimura.
Archiv fur Hydrobiologie, Vol 24, pp 155-176, 1932. 6 fig, 13 tab, 72 ref.

Descriptors: *Nitrogen compounds, *Phosphorus compounds, *Cycling nutrients, Water chemistry, Water analysis, Phosphorus, Ponds, Phytoplankton, Eutrophication, Lakes, Limnology, Aquatic environment, Aquatic productivity, Hypolimnion, Algal control, Seasonal, Annual turnover.
Identifiers: Takasuka Pond (Japan), Lake Mendota (Wis), Phytoplankton crops, Trophic, Tropholytic,

Nitrogen annual budget, Phosphorus annual budget.

Small, eutrophic Takasuka Pond, Japan, has been analyzed both vertically and seasonally (1928 to 1931) for nitrate, free ammonia, albuminoid nitrogen and soluble phosphate, and the data correlated with phytoplankton cycles. Organic nitrogen is inversely proportional to inorganic nitrogen. Inorganic nitrogen and soluble phosphate are generated at the end of stagnation caused by decomposition of warm-water phytoplankton and some aquatic plants. Seasonal change in soluble phosphate in inflowing waters affects the phytoplankton productivity. Data concerning the hypolimnion in the stagnant period (April to end of October) are presented. Calculations are offered for annual budgets for nitrogen and phosphorus in the trophic zone, tropholytic zone, and pond as a whole. Comparisons are made with lakes and ponds of the world, including Lake Mendota, Wisconsin. The limiting factor for phytoplankton crop in Takasuka is said to be 'phosphate at times and ammonia in others.' (McCoy-Wisconsin)
W69-05142

2I. Water in Plants

POPULATION, GROWTH RATE, AND MATURITY OF VEGETABLE CROPS IN RELATION TO SOIL SALINITY AND TEXTURE UNDER SPRINKLER AND FURROW IRRIGATION
California Univ., Davis, Dept. of Water Science and Engineering: California Univ., Riverside. Frank E. Robinson, and Orval D. McCoy.
Agronomy J, Vol 59, No 2, pp 178-181, March-April 1967, 7 tab, 10 ref.

Descriptors: *Vegatable crops, *Saline water, *Saline soils, *Sprinkler irrigation, *Furrow irrigation, Salts, Soil texture, Irrigation efficiency, Plant populations, Plant growth, California, Moisture uptake, Seeds, Evaporation, Soil-water-plant relationships, Moisture tension, Sands.
Identifiers: Imperial Valley (California).

A study was initiated at the University of California Imperial Valley field station to study uniformity of maturity of lettuce, cabbage, carrots, and onions, under 3 different irrigation schedules with both sprinkler and furrow systems that applied saline water to saline soils of varying textures. Conventional furrow irrigation required approximately 2.5 times as much water as was applied by sprinkler irrigation. Movement of water up into seed beds in furrow irrigation and subsequent evaporation produced an accumulation of salt in the seed rows. Downward movement of water into the soil with sprinkler application removed salts, thus preventing surface salt accumulations. (Blecker-Arizona)
W69-05074

SPATIAL PATTERN OF SHRUBS ON A DESERT PLAIN IN ETHIOPIA,
Haile Sellassie I Univ., Addis Ababa (Ethiopia).
Edward W. Beals.
Ecology, Vol 49, No 4, pp 744-746, 1968. 1 fig, 3 tab.

Descriptors: *Desert plants, *Shrubs, *Ecological distribution, *Distribution patterns, *Spatial distribution, Soil moisture, Competition, Data collections, Dispersion, Statistical methods, Seeds, Sands, Sampling, Semiarid climates, Plant populations, Dry seasons, Wet seasons.
Identifiers: *Ethiopia, Plots.

Observers have often suggested that desert shrubs show a regular spatial pattern, but statistical evidence is meager. The distribution of the shrub, Cadaba rotundifolia on a sandy plain showed a complex pattern which apparently included a trend towards aggregation, and within areas of higher density a strong trend towards regularity. The latter may result from competition for water which may occur both near the soil surface during the brief rainy periods and deep in the substrate during the more extended dry periods. A factor causing regularity was thought to be seed dispersal. Of the various methods of analyzing departure from randomness, the ratio, observed variance to expected variance, and the index of dispersion associated with it, were the most sensitive. (Affleck-Arizona)
W69-05077

GERMINATION OF FOURWING SALTBUSH SEEDS AT DIFFERENT LEVELS OF MOISTURE STRESS,
Forest Service (USDA), Albuquerque, N. Mex. Rocky Mountain Forest and Range Experiment Station.
H. W. Springfield.
Agronomy J, Vol 58, No 2, pp 149-150, March-April 1966. 2 fig, 2 tab.

Descriptors: *Germination, *Seeds, *Moisture stress, *Vegetation establishment, *Southwest U S., Air temperature, Soil temperature, Osmotic pressure, Revegetation, Semiarid climates, Soil-water-plant relationships, Ranges.
Identifiers: *Saltbush.

Studies were conducted to determine the effect of different levels of moisture stress and temperatures on seed germination of fourwing saltbush which is a promising species for seeding of arid Southwestern ranges. Six sources of seeds were germinated at moisture stress of 0.3, 3.0, 7.0, 11.0 and 15.0 atmospheres of osmotic pressure and at temperatures of 85, 63, and 49F. Germination was affected by the level of moisture stress, temperature and seed source. As moisture stress increased, germination generally was reduced regardless of temperature. The Mountainair source germinated better at moisture stresses of 11 and 15 atmospheres than 4 of the other 5 sources. This source may have characteristics that enables it to germinated more readily and thereby improve its chances of becoming established under relatively dry conditions. (Blecker-Arizona)
W69-05081

EXPERIENCE WITH THREE VAPOUR METHODS FOR MEASURING WATER POTENTIAL IN PLANTS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Land Research and Regional Survey.
H. D. Barrs, and R. O. Slatyer.
UNESCO Arid Zone Research, Vol 25, pp 369-384, 1965. 17 fig, 29 ref, disc.

Descriptors: *Plant physiology, *Leaves, *Vapor pressure, *Hygrometry, *Plant tissues, Water vapor, Instrumentation, Measurement, Equilibrium, Humidity, Calibrations, Temperature.
Identifiers: *Water potential, *Psychrometers, Vapor phase, Thermocouples, Liquid phase.

Three vapor methods were used to measure water potential in plants. The vapor exchange method involves equilibrium of discs or segments of leaf tissue being examined in microdesiccators over solutions of known water potential. The principal requirement of the apparatus is that it should provide and maintain, at the surface of the tissue under examination, a constant and known water potential in the vapor phase. The second method is that of balancing the water potential of the tissue against the water potential of vapor directly against the solution. The psychrometer method measures relative vapor pressure of small chambers using a thermocouple and thermocouple chamber. Tissue water potential of plants should be determined in order to know whether these plants could live in arid climates. (Blecker-Arizona)
W69-05085

DETERMINATION OF THE REGIONAL COEFFICIENT 'K' FOR COMPUTING THE CONSUMPTIVE USE OF NATIVE BLACK KIDNEY BEAN IN THE IRRIGATION DISTRICTS OF VERACRUZ STATE,
Irrigation and Drainage Engineering Office, Veracruz (Mexico).
Carlos Guzman Cortes.
International Commission on Irrigation and Drainage, Annual Bulletin, pp 84-90, 1967. 6 fig, 4 tab.

Descriptors: *Consumptive use, *Crop production, *Beans, *Mexico, *Border irrigation, Regional analysis, Evapotranspiration, Wells, Irrigation districts, Infiltration, Soil analysis, Water requirements, Data collections, Sampling, Irrigation efficiency.
Identifiers: *Regional coefficient, *Kidney beans.

This paper describes a study made in one of the irrigation districts in Mexico to determine the regional coefficient K for the native black kidney bean and to arrive at a basic curve for computing consumptive uses of water at various stages of crop growth. The method of border strip irrigation as adopted was best for the bean crop and yield of the crop was favorable. Data for K were decennial and the highest point for evapotranspiration corresponds to the largest consumption of water. (Blecker-Arizona)
W69-05086

CONSUMPTIVE USE OF WATER FOR SOME MAJOR CROPS IN U.A.R. (EGYPT),
Cairo Univ., Giza (Egypt). Dept. of Irrigation and Hydraulics, Ministry of Agriculture, Cairo (Egypt).
Mamdouh Shahin, and Mohamed I. El-Shal.
International Commission on Irrigation and Drainage, Annual Bulletin, pp 72-83, 1967. 8 fig, 3 tab, 16 ref.

Descriptors: *Consumptive use, *Evaporation, *Crop production, *Soil surfaces, *Soil moisture, Cotton, Wheat, Water requirements, Equations, Data collections, Moisture content, On-site investigations, Seasonal, Irrigation effects, Evapotranspiration.
Identifiers: *United Arab Republic, Maize, Formulae, Berseem.

This paper presented results of an investigation on consumptive use requirements of water for some major crops cultivated in the U. A. R. (Egypt). Maximum rate of moisture removal took place at the surface 10-cm layer of soil. Over 80% of total moisture extraction was confined to the uppermost 50 cm of soil. Consumptive use found experimentally for each of the investigated crops (cotton, wheat, maize, berseem) followed a particular trend that changed slightly from one location to another. Data on consumptive use obtained from field measurements have been substituted in a number of formulas developed for estimating evaporation and evapotranspiration. A new formula for estimating the daily consumptive use of a crop has been developed. (Blecker-Arizona)
W69-05087

INFLUENCE OF SOIL WATER POTENTIAL AND ATMOSPHERIC EVAPORATIVE DEMAND ON TRANSPIRATION AND THE ENERGY STATUS OF WATER IN PLANTS.
Utah State Univ., Logan.
S. A. Gavande, and S. A. Taylor.
Agronomy J, Vol 59, No 1, pp 4-7, Jan-Feb 1967. 8 fig, 15 ref.

Descriptors: *Soil moisture, *Evaporation, *Turgidity, *Transpiration, *Energy, Orchardgrass, Tomatoes, Air temperature, Humidity, Light intensity, Moisture stress, Moisture uptake, Soil-water-plant relationships, Stomata, Plant growth, Water balance, Environmental effects, Leaves, Osmotic pressure.
Identifiers: *Soil water potential, Atmospheric evaporative demand, Osmotic potential, Turgor potential.

Orchardgrass and tomato plants were subjected to varying soil moisture conditions. Constant atmospheric evaporative demand conditions were maintained by controlling temperature, relative humidity, light intensity and hours of daylight while plants were carried through one series of soil moisture conditions. The total plant water poten-

tial, the osmotic potential, turgor potential and transpiration losses from the two plant species were influenced by soil water potential and atmospheric evaporative demand. The influence of the atmospheric demand was more marked in moist than in drier soil. High atmospheric evaporative demand caused by a combination of high temperature and low relative humidity increased steepness of the water potential gradient between the leaf and the air, thus increasing the transpiration rate. (Blecker-Arizona)
W69-05088

PHENOLOGICAL ASPECTS OF A FEW PROMISING EUCALYPTUS IN THE ARID ZONE,
Central Arid Zone Research Inst., Jodhpur (India). Div. of Resource Utilization Studies.
R. N. Kaul.
Science and Culture, Vol 33, No 6, pp 289-291, June 1967. 1 tab.

Descriptors: *Reproduction, *Flowering, *Genetics, *Trees, *Phenology, Seeds, Sexual maturity, Vegetation, Soil moisture, Humidity, Air temperature, Arid climates, Plant growth, Age.
Identifiers: *Eucalyptus, India, Fruiting, Exotic plants.

A good test of a successful exotic is that it should be able to reproduce itself by seed propagation or vegetatively. Species of Eucalyptus were planted at Jodhpur to determine their flowering age which is one of the important factors in determining the degree of genetic improvement. The minimum flowering was 7 months and 17 days. Most of the species fell within the range of four to four and one-half years. Soil moisture, atmospheric humidity, and comparatively low ambient temperatures, were the controlling factors for the initiation of flowering. The species exhibited marked variation in the percentage of the trees that flowered. This variation between the individuals of the species may be due to initial differences in their growth and vigor. (Blecker-Ariz)
W69-05091

MEASUREMENT OF THE WATER POTENTIAL OF INTACT PLANT TISSUES III. THE WATER POTENTIALS OF GERMINATING PEAS (PISUM SATIVUM L.),
Nottingham Univ. (England). Dept. of Horticulture.
Man Singh Manohar.
J Experimental Botany, Vol 17, pp 231-235, 1966. 1 fig.

Descriptors: *Seeds, *Germination, *Hydrometry, *Measurement, *Plant growth, Osmosis, Root development.
Identifiers: *Water potential, *Peas, Thermocouple, Distilled water.

A microthermocouple psychrometer was used to measure the water potential over part of the surface of a pea seed. Pea seeds subjected to an external water potential below 6,000 joules per kg germinate at a lower internal water potential than they exhibit in distilled water. The water potentials of the seeds decreased just after radicle emergence until the radicle establishes contact with its germination medium. No detectable amounts of osmotically active substances are exuded from the seed during germination. In order to obtain information on their germination performance in arid climates, the seed's water potential could be measured by the method outlined above. (Blecker-Ariz)
W69-05095

2J. Erosion and Sedimentation

ENTRY VELOCITY CONTROL LIMITS DRAIN SEDIMENTATION,
Agricultural Research Service, Brawley, Calif.; and Agricultural Research Service, Columbus, Ohio.
For primary bibliographic entry see Field 08B.
W69-04720

ELECTRONIC DATA PROCESSING SYSTEM FOR STREAMFLOW,
Southern Great Plains Watershed Research Center, Chickasha, Okla.
For primary bibliographic entry see Field 07C.
W69-04759

SEDIMENT DATA FOR CANADIAN RIVERS, WATER YEAR 1966.
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.

Inland Waters Br, Dep Energy, Mines and Resources Data Rep, 1969. 155 p, 1 map.

Descriptors: *Sediment load, *Rivers, *Suspended load, *Data collections, Sediment discharge, Sediment yield, Streamflow, Discharge (Water), Sediment transport, Stream gages, Sampling.
Identifiers: *Canada, Sediment sampling.

Data on the quantity and character of stream-transported sediment in Canada for water year 1966 are tabulated for use as a basis for studies of river channel morphology, erosion, deposition, and water resources. The sampling equipment used is described. Each sampling station record includes location of station, drainage area, type of gage, period of record, mean discharge, extremes of discharge and sediment load, history of station, remarks on record quality, monthly mean sediment load, and daily suspended load data. Particle-size analyses are included in some records. (Knapp-USGS)
W69-04766

LOCALIZED SCOUR IN ERODIBLE-BED CHANNELS,
Universidad de la Republica, Montevideo (Uruguay). Facultad de Ingenieria Agrimensura; New York Univ., N. Y. Courant Inst. of Mathematical Sciences.
Mario H. Gradowczyk, Oscar J. Maggiolo, and Hugo C. Folguera.
J Hydraul Res, Vol 6, No 4, pp 289-326, 1968. 38 p, 14 fig, 1 tab, 24 ref.

Descriptors: *Scour, *Alluvial channels, *Flow around objects, *Mathematical models, Reynolds number, Froude number, Turbulence, Digital computers, Hydraulic models, Model studies.
Identifiers: *Erodible-bed channels.

A mathematical model to predict scour around isolated obstacles in erodible-bed channels gives numerical results in good agreement with experimental work in laboratories. Depth of scour is calculated as a function of obstacle width and water depth, using a shear intensity number calculated for the undisturbed flow. Results of experimental studies are shown by tables and graphs. The model is compared with several other models of bed scour and gives better results. (Knapp-USGS)
W69-04788

A SCALE MODEL STUDY OF SILTING IN THE VILAINE RIVER DUE TO THE ARZAL DAM (FRENCH),
French Central Hydraulic Lab, France.
For primary bibliographic entry see Field 02A.
W69-04795

A STUDY OF THE PHYSICAL PROPERTIES OF VARIOUS FORMS OF VERY FINE SEDIMENTS AND THEIR BEHAVIOR UNDER HYDRODYNAMIC ACTION (FRENCH),
French Central Hydraulic Lab.
C. Migniot.
La Houille Blanche (Rev of French Hydrotech Soc), No 7, pp 591-620, 1968. 30 p, 57 fig, 6 tab.

Descriptors: *Silts, *Mud, *Sediments, *Physical properties, Hydrodynamics, Model studies, Flocculation, Sediment load, Runoff, Chemical analysis, Shrinkage, Sands, Turbidity, Rigidity, Erosion.
Identifiers: Laboratory research, France, Samples from abroad.

Some basic physical properties of very fine sediment samples collected from various localities in France and abroad were investigated at the French Central Hydraulic Laboratory for evaluation of the dynamics of the sediments. The study shows that the flocculation of suspensions, the settling time of deposits, and the rheological characteristics of deposits may be considered as the basic properties of very fine sediments. In general, the process of suspension and deposition of these fine sediments in various soil-water complexes behave in a similar way under a hydrodynamic action, if their basic properties are somewhat similar. In particular, the slope of a submerged or emergent mud bank, tan alpha, will be proportional for an assumed 40-cm height of deposit to the initial rigidity r sub y, as follows: tan alpha = Kr sub y, where K is about 25/100 and 7/100 for a submerged and above-the-water deposit, respectively. Similarly, the critical bed friction velocity U can be related to initial velocity as follows: U = 0.5 r sub y to the 1/2 power, where r sub y is dynes/cm squared for deposits of initial rigidity greater than 10 dynes/cm squared. (Gabriel-USGS)
W69-04796

SUMMARY AND ANALYSIS OF SEDIMENT RECORDS IN RELATION TO ST. LOUIS HARBOR SEDIMENTATION PROBLEM,
Geological Survey, Washington, D. C.
P. R. Jordan.
Prepared in cooperation with U S Army Corps of Engineers, St. Louis, Mo. Geol Surv open-file rep, 1968. 30 p, 11 fig, 3 tab, 6 ref.

Descriptors: *Silting, *Sedimentation, *Harbors, *Mississippi River, *Missouri River, Sediment transport, Streamflow, Scour, Particle size, Suspended load, Channel morphology.
Identifiers: St. Louis Harbor (Mo).

Records of sediment discharge in the Mississippi and Missouri Rivers at St. Louis, Missouri, are compiled and analyzed in a study of silting in the St. Louis harbor docking area on the Mississippi River. The combined flows of the lower Missouri and upper Mississippi Rivers commonly transport more suspended sediment, and sand in particular, than does the flow of the Mississippi River at St. Louis, resulting in deposition of sediment between Hermann and St. Louis in many years. Impoundments in the Missouri River basin have reduced the suspended-sediment discharge by at least 25% at Kansas City, but have had little effect on the discharge of sand which constitutes most of the deposition. According to the calculations presented, the depth would be inadequate for docking at the Municipal Dock and some of the other docks about 9% of the time. However, this estimate should be used with caution because of the limitations of the data from which the assumptions and calculations were made. It is probably safe, however, to conclude that, in the absence of major changes in water use, river regulation, and channel geometry, troublesome deposits of sand will continue to be found periodically near the barge terminals. (Knapp-USGS)
W69-04938

BED-MATERIAL MOVEMENT, MIDDLE FORK EEL RIVER, CALIFORNIA,
Geological Survey, Sacramento, Calif.
John R. Ritter.
Geol Surv Res 1967, Prof Pap 575-C, PP C219-C221, 1967. 3 p, 5 fig, 1 tab, 5 ref.

Descriptors: *Bed load, *Gravels, Tractive forces, Velocity, Discharge (Water), Particle size, California.
Identifiers: Eel River (Cal), Cobbles.

The Middle Fork Eel River, at a discharge of about 3,750 cfs and an average velocity of about 6 fps, moved bed material of cobble size. The size of the transported material was determined by actually noting, through the use of photographs, which individual rocks had been removed from painted areas on the riverbed, particle size of these rocks is proportional to average velocity and to tractive force. (USGS)
W69-04980

WINTER LOSS AND SPRING RECOVERY OF DISSOLVED SOLIDS IN TWO PRAIRIE-POTHOLE PONDS IN NORTH DAKOTA,
Geological Survey, Lincoln, Nebr.

James H. Ficken.
Geol Surv Res 1967, Prof Pap 575-C, pp C228-C231, 1967. 4 p, 3 fig, 1 tab, 2 ref.

Descriptors: *Water chemistry, *Potholes, *Playas, *Ponds, *Sediments, Ice, Diffusion, Freezing, North Dakota.
Identifiers: Prairie potholes.

A temporary loss of more than 25% of dissolved-solids tonnage was detected in 2 prairie-pothole ponds in each of several winters. Analyses of ice, water beneath the ice, and water in the bed material suggest that 'lost' dissolved solids were stored temporarily in the bed material. Probably dissolved solids migrate by diffusion into the bed as the ice thickens and migrate back after the ice melts. Full recovery of the loss required at least several weeks. The slowness of recovery may be due to a slow rate of diffusion from the bed material. (USGS)
W69-04983

2K. Chemical Processes

CHEMICAL MEASUREMENT OF MEAN TEMPERATURE,
Pennsylvania State Univ., University Park.
For primary bibliographic entry see Field 07A.
W69-04765

APPLICATION AND LIMITATIONS OF CHEMICAL THERMODYNAMICS IN NATURAL WATER SYSTEMS,
California Inst. of Tech., Pasadena. W. M. Keck Lab. of Environmental Health Engineering.
James J. Morgan.
Symp on Equilibrium Conc in Natur Water Supt, Advance in Chem Ser 67, pp 1-29, 1967. 29 p, 13 fig, 38 ref. PHS Grant WP-00941.

Descriptors: *Thermodynamics, *Aqueous solutions, *Equilibrium, Solubility, Solutes, Water chemistry, Chemical potential, Chemical reactions, Alluminum, Manganese, Iron, Oxygen, Oxidation.
Identifiers: Open-system thermodynamics, Closed-system thermodynamics, Buffered solutions.

Studying thermodynamic relationships at constant temperature and pressure permits comparison between actual chemical composition of a natural water system and the equilibrium composition of a model closed system. Comparing the composition of the equilibrium model with that of the actual natural water system is an important step in understanding the real system. In contrast to closed-system models, for which the time-invariant state is equilibrium, the stationary state is the corresponding state of open systems. Three different chemical systems in natural waters illustrate these principles: homogeneous and heterogeneous buffer capacities in natural waters, hydrolysis reactions of aqueous aluminum, and the oxidation of reduced manganese by oxygen. (Knapp-USGS)
W69-04770

THE MECHANISM OF PHOTOSYNTHETIC USE OF BICARBONATE BY HYDRODICTYPN AFRICANUM,
Cambridge Univ. (England) Botany School.
J. A. Raven.
J Exp Bot, Vol 19, No 58, pp 193-206, Feb 1968. 5 fig, 1 tab, 31 ref.

Descriptors: *Algae, *Carbonates, *Carbon dioxide, *Bicarbonates, *Photosynthesis, Aquatic algae, Aquatic microbiology, Cycling nutrients, Essential nutrients, Environmental effects, Light intensity, Photosynthetic oxygen, Physiological ecology.

Hydrodictyon africanum can photosynthesize at high pH under conditions in which bicarbonate ion rather than carbon dioxide is the carbon species entering the cell. Since a four-fold variation in the concentration of bicarbonate ion does not influence the fixation rate under low light at low temperature, a passive entry seems unlikely; a metabolic bicarbonate ion pump is proposed. It is possible that such a pump is related to a light-dependent reaction specific to the use of bicarbonate ion. On a basis of moles of carbon fixed, bicarbonate ion use is more sensitive to N- (3,4 dichlorophenyl)-N', N'-dimethylurea than is carbon dioxide use. Carbonyl cyanide meta-chlorophenylhydrazone inhibits both processes by the same absolute amount. Therefore, bicarbonate ion use is dependent on photosystem 2, but is independent of adenosine triphosphate. These characteristics are similar to those of active light-dependent chlorine influx in H africanum and suggest a similar energy source for the two pumps. The bicarbonate ion pump may be electrogenic. (Fitzgerald-Wis)
W69-04803

TRACE INORGANICS IN WATER,
Robert A. Baker.
Symp by Div of Water, Air, and Waste Chem: 153rd Meeting, Amer Chem Soc, Miami Beach, Fla, Apr 1967. Advances in Chem Ser 73, Amer Chem Soc, 1968. 396 p, 21 chapters, index.

Descriptors: *Trace elements, *Inorganic compounds, *Water chemistry, *Water structure, *Water properties, *Chemical analysis, Biological properties, Physicochemical properties, Chemical properties, Flame photometry, Fluorometry, Neutron activation analysis, Polarographic analysis, Radiochemical analysis, Chromatography, Spectrophotometry.
Identifiers: Water chemistry symposium, Trace inorganic determination in water, Natural water systems, Atomic fluorescence analysis.

Recent advances in the determination of trade inorganics in water and in the study of their relationships to water structure and water use by organisms are discussed in a symposium of 21 papers. The topics presented include critical assessments of broad subjects, applied and fundamental research reports, and analytical developments. Inorganic materials are involved in corrosion, eutrophication, and microbiological processes of economic and general concern. Water structure, effects of trace inorganics on the ice/water system, weathering, and biological effects of trace inorganics are discussed. New analytical methods include automatic microanalysis, polarography, atomic absorption, extraction techniques, neutron activation analysis, and atomic fluorescence. (Knapp-USGS)
W69-04962

MASTER VARIABLES AND ACTIVITY SCALES,
Royal Inst. of Tech., Stockholm (Sweden).
Lars Gunnar Sillen.
Symp of Equilibrium Conc in Natur Water Syst, Advance in Chem Ser 67, pp 45-56, 1968. 12 p, 5 fig, 18 ref.

Descriptors: *Aqueous solutions, *Equilibrium, *Ions, Solubility, Electrolytes, Solutes, Water chemistry, Chemical potential, Chemical reactions, Hydrogen ion concentration, Oxidation, Reduction (Chemical), Oxidation-reduction potential.
Identifiers: Ionic activities, Electron activity.

The infinite dilution activity scale is useful for calculating ionic equilibria in fresh waters, but for equilibria in sea water one gains precision by applying an ionic medium activity scale. Measuring pH in sea water gives less information than total alkalinity and total carbonate. Calculations on redox equilibria are simplified by introducing the master variable pE = (-log electron activity). (Knapp-USGS)
W69-04963

GIBBS PHASE RULE AND MARINE SEDIMENTS,
Royal Inst. of Tech., Stockholm (Sweden).
Lars Gunnar Sillen.
Symp on Equilibrium Conc in Natur Water Syst, Advance in Chem Ser 67, pp 57-69, 1968. 13 p, 2 fig, 1 tab, 24 ref.

Descriptors: *Aqueous solutions, *Mineralogy, *Equilibrium, Ions, Sea water, Sediments, Air, Zeolites, Calcite, Clays, Quartz, Silica, Sodium, Potassium, Aluminum, Chlorides.
Identifiers: Gibbs phase rule.

An imaginary equilibrium model of the sea water + sediment + air system is constructed by adding the components successively. The working hypothesis is proposed that in an intermediate model, with the eight components water - HCl - silica - Al hydroxide - NaOH - KOH - MgO - CaO, seven phases would be at equilibrium: (1) an aqueous solution of composition like sea water, (2) quartz, (3) kaolinite, (4) hydromica (illite), (5) chlorite, (6) montmorillonite, (7) phillipsite or some other zeolite. The composition of the solution and of each solid phase will be fixed once p, T, and chloride ion are given. Adding carbon dioxide brings calcite; adding FeO and iron oxide brings glauconite and geothite. Studies of separated clay phases are highly desirable. (Knapp-USGS)
W69-04964

THE STRUCTURE OF WATER AND WATER-SOLUTE INTERACTIONS,
Miami Univ., Fla. Inst. of Marine Science.
W. Drost-Hansen.
Symp on Equilibrium Conc in Natur Water Syst, Advance in Chem Ser 67, pp 70-120, 1968. 51 p, 12 fig, 162 ref.

Descriptors: *Water structure, Solutes, Water chemistry, Molecular structure, water properties, Viscosity, Refractivity, Density, Solubility, Thermodynamics, Water chemistry.
Identifiers: Proton spin, Infrared absorption, Specific heat, Water thermal anomalies.

Thermal anomalies in the properties of water and aqueous solutions appear to be manifestations of higher-order phase transitions in structured elements of water. Some concentration-dependent anomalies are also described and discussed in terms of: (a) the occurrence of discrete structural units of water in the unaffected solvent, (b) the possible separate existence of somewhat similarly structured units in the ionic hydration atmospheres, and (c) overlapping of large (but not necessarily structured) hydration atmospheres. (Knapp-USGS)
W69-04965

AQUEOUS SURFACE CHEMISTRY OF OXIDES AND COMPLEX OXIDE MINERALS,
Stanford Univ., Calif.
George A. Parks.
Symp on Equilibrium Conc in Natur Water Syst, Advance in Chem Ser 67, pp 121-160, 1968. 40 p, 13 fig, 7 tab, 95 ref. AT (04-3)326 C.A. No. 3.

Descriptors: *Water chemistry, *Chemical potential, Adsorption, Ions, Settling velocity, Suspension, Colloids, Aqueous solutions, Water structure, Hydrogen ion concentration, Ion exchange, Ionization.
Identifiers: Isoelectric point, Surface charges, Surface chemistry.

The factors controlling the sign and magnitude of surface charges on particles of oxides and minerals in aqueous suspension are summarized. Surface charges are responsible for such behavior as ion exchange, electrolyte adsorption, formation of colloids, and coagulation. It is useful to define the zero point of charge (ZPC) or isoelectric point of the solid. ZPC designates the pH in any system, however complex, at which there is no net charge on the solid particles of interest. If the charge is formed only by H or OH ions, water, and species interacting with them, then the ZPC is given the special name IEP. ZPC can be estimated by maximum coagulation or sedimentation rates, minimum ion exchange rates, streaming potential, of H and OH ionic adsorption. Models are developed to correlate measured ZPC and IEP with solid composition, calculating values for new species, and predicting behavior of particles. The factors which determine many surface reactions in nature are discussed. (Knapp-USGS)
W69-04966

THE NATURE OF INORGANIC SOLUTE SPECIES IN WATER,
North Carolina Univ., Chapel Hill.
S. Y. Tyree, Jr.

Symp on Equilibrium Conc in Natur Water Syst, Advance in Chem Ser 67, pp 183-195,1968. 13 p, 3 fig, 1 tab, 46 ref.

Descriptors: *Water chemistry, *Ions, *Solutes, *Hydrolysis, Chemical precipitation, Hydrates, Hydration, Solvation, Chemical reactions, Hydrogen ion concentration, Chelation.
Identifiers: Chemical kinetics, Isopolyions.

In the range of pH exhibited by most natural water and in the concentration range greater than millimolar, few metal ions exist as simple hydrated cations, and relatively few oxyanions exist as simple monomeric species. The hydrated cations are good buffers toward bases, the metallate ions toward acids. As pH is raised in solutions of many hydrated cations, isopolycations are produced, and ultimately, hydrous metal oxides precipitate. As pH is lowered in solutions of many metallate ions, isopolyanions are produced, and ultimately, hydrous oxides precipitate. Salts of the intermediate isopolyions precipitate in some cases. Where the results are unambiguous, the nature of the intermediate species can be described. Kinetics are thought to have been neglected in studies of such solutions up to the present time. (Knapp-USGS)
W69-04967

HETEROGENEOUS EQUILIBRIA INVOLVING OXIDES, HYDROXIDES, CARBONATES, AND HYDROXIDE CARBONATES,
National Bureau of Standards, Washington, D. C.
Paul W. Schindler.
Symp on Equilibrium Conc in Natur Water Syst, Advance in Chem Ser 67, pp 196-221, 1968. 26 p, 8 fig, 10 tab, 63 ref, 1 append.

Descriptors: *Water chemistry, *Sea water, *Equilibrium, Chemical precipitation, Aqueous solutions, Carbon dioxide, Solubility, Solutes, Hydrolysis, Chemical potential, Chemical reactions, Thermodynamics.
Identifiers: Heterogeneous equilibria, Steady state chemistry, Sea water chemistry.

The law of mass action in the solid-water-atmospheric gas system is discussed in relation to the mechanism of control of the concentrations of some major and minor constituents of sea water by simple solubility equilibria. Comparison of calculated and observed concentrations suggests that the ocean is a steady-state system in which the degree of oversaturation of a constituent is related to its rate of sedimentation. Recent laboratory work on heterogeneous systems is summarized. The chemical species discussed belong to ternary systems of the type metal ion-water-carbon dioxide. (Knapp-USGS)
W69-04968

ORIGIN OF THE CHEMICAL COMPOSITIONS OF SOME SPRINGS AND LAKES,
Northwestern Univ., Evanston, Ill.; Bermuda Biological Stations, St. George's West.
Robert M. Garrels, and Fred T. MacKenzie.
Symp on Equilibrium Conc in Natur Water Syst, Advance in Chem Ser 67, pp 222-242, 1968. 21 p, 4 fig, 9 tab, 8 ref. Grant GP-4140 NSF.

Descriptors: *Water chemistry, *Springs, *Alkaline water, Weathering, Lakes, Sodium, Calcium, Carbonates, Bicarbonates, Aqueous solutions, Equilibrium, Chemical precipitation, Evaporation, Quartz, Mineralogy, Clays.
Identifiers: Sierra Nevada (Cal), Feldspar weathering.

The spring waters of the Sierra Nevada result from the attack of soil waters on high carbon dioxide concentration on typical igneous rocks and hence can be regarded as nearly ideal samples of a major water type. Their compositions are consistent with a model in which the primary rock-forming silicates are altered in a closed system to soil minerals plus a solution in steady-state equilibrium with these minerals. Isolation of Sierra waters from the solid alteration products followed by isothermal evaporation in equilibrium with the earth's atmosphere should produce a highly alkaline sodium-bicarbonate-carbonate water; a soda lake with calcium carbonate, magnesium hydroxy-silicate, and amorphous silica as precipitates. (Knapp-USGS)
W69-04969

EQUILIBRIUM MODELS AND COMPOSITION OF THE GREAT LAKES,
Syracuse Univ., N. Y. Dept. of Geology.
James R. Kramer.
Symp on Equilibrium Conc in Natur Water Syst, Advance in Chem Ser 67, pp 243-254, 1968. 12 p, 7 fig, 2 tab, 16 ref.

Descriptors: *Water chemistry, *Equilibrium, *Great lakes, Solutes, Solubility, Mineralogy, Calcium, Magnesium, Carbonates, Carbon dioxide, Calcite, Dolomite, Temperature, Chemical reactions, Chemical precipitation.
Identifiers: Apatite, Steady state chemistry.

A model of Great Lakes water composition involves the equilibrium of calcite, dolomite, apatite, kaolinite, gibbsite, and feldspars at 5 deg C with air having a partial pressure of carbon dioxide of 0.00035, and water. With carbon dioxide pressure and temperature variable and other concentrations fixed, cold waters contain excess carbon dioxide and are unsaturated in calcite, dolomite, and apatite, whereas warm waters are nearly at equilibrium with carbon dioxide but are somewhat supersaturated in calcite, dolomite, and apatite. (Knapp-USGS)
W69-04970

COORDINATION CHEMISTRY OF THE OCEANS,
University of South Florida, Tampa.
Dean F. Martin.
Symp on Equilibrium Conc in Natur Water Syst, Advance in Chem Ser 67, pp 255-269, 1968. 15 p, 3 tab, 45 ref.

Descriptors: *Water chemistry, *Sea water, Chelation, Chemical reactions, Solubility, Red tide, Solvation, Hydrolysis, Ions, Ion exchange, Hydrogen ion concentration, Carbonates, Magnesium, Calcium.
Identifiers: *Coordination chemistry, Coordination compounds, Complexes, Complex ions, Lability, Ligands.

The coordination chemistry of sea water represents a new and useful approach to understanding the chemical properties of sea water. The coordination chemistry of sea water differs from contemporary coordination chemistry in the following respects: most complexes involve pretransition metals, most complexes are labile, the ligands are simpler (water, hydroxide, chloride, carbonate, sulfate), and time and space are important parameters. Principles of coordination chemistry are applied to contemporary research in marine science in four areas: analysis of constituents of natural waters, the nature of metallic species in the oceans, the Red Tide problem, and carbonate geochemistry. (Knapp-USGS)
W69-04971

REDOX EQUILIBRIA AND MEASUREMENTS OF POTENTIALS IN THE AQUATIC ENVIRONMENT,
Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
J. Carrel Morris, and Werner Stumm.
Symp on Equilibrium Conc in Natur Water Syst, Advance in Chem Ser 67, pp 270-285, 1968. 16 p, 7 fig, 1 tab, 17 ref.

Descriptors: *Water chemistry, *Equilibrium, *Oxidation, *Reduction (Chemical), Oxidation-reduction potential, Biochemistry, Carbon, Nitrogen, Oxygen, Sulfur, Iron, Manganese, Chemical analysis.
Identifiers: Natural water systems, Redox equilibria.

Equilibrium models are valuable in interpreting the e stability relations of pertinent redox components in n natural water systems. Unfortunately, concentrations of oxidizable or reducible species may be far r from those predicted thermodynamically because e many redox reactions are slow. Maintenance of life s resulting directly from a steady input of solar energy is also a major cause on nonequilibrium conditions. Nonphotosynthetic organisms, however, tend t to restore equilibrium by catalytically decomposing, through energy-yielding redox reactions, the s unstable ultimate products of photosynthesis. Measuring redox potentials frequently yields results s that are not amenable to unambiguous interpretation. Quantitative interpretation with respect to solution composition is frequently not justified because the required electrochemical reversibility is usually not attained. Moreover, the point of zero-applied current is not necessarily the equilibrium potential. Most redox-potential measurements on natural waters represent mixed potentials. (Knapp-USGS)
W69-04972

SOME pH-CONTROLLING REDOX REACTIONS IN NATURAL WATERS,
Scripps Institution of Oceanography, LaJolla, Calif.
K. Bostrom.
Symp on Equilibrium Conc in Natur Water Syst, Advance in Chem Ser 67, pp 286-311, 1968. 26 p, 8 fig, 6 tab, 50 ref. NSF-GP5112.

Descriptors: *Water chemistry, *Oxidation, *Reduction (Chemical), *Hydrogen ion concentration, Equilibrium, Alkalinity, Acidity, Carbon dioxide, Oxygen, Mineralogy, Sulfides, Manganese, Iron, Sediments, Solutes, Solubility, Model studies.
Identifiers: Redox reactions, Buffered systems.

Using stoichiometric model systems, it can be shown that some naturally occurring redox processes have a pronounced pH-controlling action, even in the presence of substances that act as buffers. High pH values can be reached particularly in systems where higher metal oxides act as oxidizers whereas an acid condition often develops when free oxygen is the oxidizer. However, in most natural systems carbonates and silicates have a more pronounced pH controlling effect than redox processes. (Knapp-USGS)
W69-04973

BIOLOGICAL ACTIVITY IN RELATION TO THE CHEMICAL EQUILIBRIUM COMPOSITION OF NATURAL WATERS,
Wisconsin Univ., Madison. Water Chemistry Lab.
Fred G. Lee, and Alfred W. Hoadley.
Symp on Equilibrium Conc in Natur Water Syst, Advance in Chem Ser 67, pp 319-338, 1968. 20 p, 2 fig, 1 tab, 70 ref. Grant 5TI-WP-22-04 FWPCA.

Descriptors: *Water chemistry, *Biochemistry, *Equilibrium, Ions, Solutes, Chemical reactions, Hydrogen ion concentration, Oxidation, Reduction (Chemical), Hydrolysis, Sorption, Chemical precipitation, Respiration, Photosynthesis, Acidity, Alkalinity.
Identifiers: Complex ions, Protolysis.

For many elements, the concentration of a species in a given body of water can be predicted by abiotic chemical reactions such as protolysis, precipitation, complexation, redox, and sorption. Aquatic organisms can influence the concentration of compounds directly by metabolic uptake, transformation, storage, and release. Aquatic organisms may also cause chemical reactions by changing the concentrations of solutes which are important in abiotic equilibria. The two most important reactions of this type are changes in the pH of the water as a result of respiration and photosynthesis and the uptake and release of organic compounds. Both of these reactions can influence acid-base, precipitation, complexation, redox, and sorption reactions in natural waters. (Knapp-USGS)
W69-04974

CHEMICAL CHARACTERISTICS OF BULK PRECIPITATION IN THE MOJAVE DESERT REGION, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
J. H. Feth.
Geol Surv Res 1967, Prof Pap 575-C, pp C222-C227, 1967. 6 p, 2 fig, 2 tab, 7 ref.

Descriptors: *Precipitation (Atmospheric), *Water chemistry, *Water quality, Chemical analysis, Dusts, Calcium, Silica, Magnesium, Sodium, Potassium, Bicarbonates, Sulfates, Chlorides, Nitrates.
Identifiers: Mojave Desert (Calif), Bulk precipitation.

Analyses of 41 samples of bulk precipitation from 12 places in the Mojave Desert region show wide ranges of dissolved-solids concentration and a variety of chemical types, although the calcium bicarbonate type water dominates. Specific conductance of the solutions analyzed ranged from 8.9 to 823 micromhos and shows strong inverse correlation with quantities of rain but no discernible correlation with time of exposure of the gage between samples. Dust that locally includes saline materials appears directly to govern the chemical type and concentration of a few samples. Bulk precipitation in the Mojave is closely similar to bulk precipitation sampled at Menlo Park, Calif., near the coast, in the San Francisco Bay area. (USGS)
W69-04982

HYDROGEOLOGIC SIGNIFICANCE OF CALCIUM-MAGNESIUM RATIOS IN GROUND WATER FROM CARBONATE ROCKS IN THE LANCASTER QUADRANGLE, SOUTHEASTERN PENNSYLVANIA,
Geological Survey, Harrisburg, Pa.
For primary bibliographic entry see Field 02F.
W69-04985

EFFECT OF SEAWEED ON THE LEVELS OF AVAILABLE PHOSPHORUS AND NITROGEN IN A CALCAREOUS SOIL,
Chile Univ., Santiago. Faculty of Chemistry and Pharmacy.
Mario Caiozzi, Pedro Peirano, Eduardo Rauch, and Hugo Zunino.
Agron J, Vol 60, pp 324-326, 1968. 6 fig, 3 tab, 15 ref.

Descriptors: *Calcareous soils, *Phosphorus, *Nitrogen compounds, Nitrogen, Nitrates, Phosphates, Loam, Eutrophication, Cycling nutrients, Aquatic plants.
Identifiers: *Seaweed, Macrocystis intergrifolia, Silt loam.

In samples of a calcareous silt loam (pH 7.7), supplemented with potassium nitrate and diacid potassium phosphate and incubated with seaweed (Macrocystis intergrifolia at 4 g/400 g soil), there was an increase in available phosphorus and immobilization of nitrate-nitrogen. Results also indicated that inorganic phosphorus of seaweed origin was probably in a form other than simple phosphate. (Konrad-Wisconsin)
W69-05136

THE FATE OF NITRATE NITROGEN IN SOME TROPICAL SOILS FOLLOWING SUBMERGENCE,
International Rice Research Inst., Los Banos, Laguna (Philippines).
I. C. MacRae, Rosabel R. Ancajas, and S. Salandanan.
Soil Sci, Vol 105, No 5, pp 327-334, 1968. 8 fig, 1 tab, 8 ref.

Descriptors: *Nitrates, *Nitrogen compounds, *Tropical regions, *Soils, Denitrification, Organic matter, Analytical methods.
Identifiers: *Submerged soils, Nitrogen isotopes, Philippines.

In laboratory experiments, labeled potassium nitrate was added to six Philippine soils immediately before flooding. Total nitrogen, nitrate plus nitrite, potassium chloride-extractable ammonium-nitrogen and organic nitrogen, and nitrogen-15 in each of these fractions were determined periodically throughout a six-week period of submergence. Denitrification was rapid after flooding, especially in soils containing the highest levels of organic matter; ammonium-nitrogen increased in all soils after submergence, finally attaining concentrations of 56-346 ppm. Total nitrogen-15 in the soil decreased after submergence and, after two weeks, disappeared completely from the two soils with the highest organic matter contents (8 and 4.8%). The amount of nitrogen-15 detected in the other soils after submergence for six weeks represented 8-41% of the labeled nitrate. From 4.5 to 39% of nitrogen-15 was recovered from the organic fraction of four of the soils after submergence for six weeks. (Konrad-Wisconsin)
W69-05138

2L. Estuaries

ESTUARIES AND SOUNDS OF NORTH CAROLINA,
Geological Survey, Raleigh, N. C.
Hugh B. Wilder.
Water Resources Bull, Vol 4, No 4, pp 28-38, Dec 1968. 11 p, 9 fig.

Descriptors: *Estuaries, *North Carolina, Hydrology, Water quality, Streamflow, Saline water intrusion, Tides, Winds, Currents (Water), Recreation, Scenery.
Identifiers: *North Carolina estuaries.

The estuaries and sounds of North Carolina are described in terms of tides, river flow, saline water intrusion, and use. Water velocities in the estuaries are very low and the wind-induced currents are often faster than streamflow or tidal currents. The tidal range of estuaries opening into the ocean is about 4 ft, and in estuaries opening into sounds it is about 1 ft. The length of salt water intrusion depends on winds, tides, streamflow, and channel shape, and varies from about 20 to 50 miles. At present the North Carolina estuaries are relatively unspoiled esthetically by pollution and shoreline development. Planning is necessary to preserve their esthetic values. (Knapp-USGS)
W69-04758

PREDICTION OF THE EXTENT OF SALT-WATER INTRUSION INTO ESTUARIES AND SEAS,
Rijkswaterstaat-Service for the Delta Works, The Hague (Netherlands).
P. van der Burgh.
J Hydraul Res, Vol 6, No 4, pp 267-288, 1968. 22 p, 17 fig, 2 tab, 2 ref.

Descriptors: *Saline water intrusion, *Estuaries, *Channel improvements, Navigation, Tides, Currents (Water), Streamflow, Canals, Coasts, Sea water, Water levels.
Identifiers: Netherlands.

A method was developed to calculate the effect of channel modifications on saline water intrusion and tidal flows in estuaries. Small changes in channel depth are shown to cause large changes in length of saline water intrusion. The Rotterdam Waterway, the Netherlands, has been studied for the past 60 yr, and the effects of many channel changes are analyzed and presented by graphs. An empirical relationship between channel deepening and intrusion length is given. (Knapp-USGS)
W69-04782

A SCALE MODEL STUDY OF SILTING IN THE VILAINE RIVER DUE TO THE ARZAL DAM (FRENCH),
French Central Hydraulic Lab, France.
For primary bibliographic entry see Field 02A.
W69-04795

WATER BALANCE OF LAKE AFFECTED BY SEA (FRENCH),
State Inst. of Hydrology and Meteorology, Warsaw (Poland).
For primary bibliographic entry see Field 02H.
W69-04960

SPORT FISHING SURVEY OF THE LOWER POTOMAC ESTUARY,
Charles M. Frisbie, and Douglas E. Ritchie, Jr.
Chesapeake Science, Vol 4, No 4, December, 1963, pp 175-191.

Descriptors: *Sport fishing, *Surveys, *Fish harvest, *Bays, Census, Fishing, Recreation, Water sports, Maryland, Appalachian Mountain region, Atlantic coastal plain, Coastal plains, Geographical regions, Northeast U. S., Regions, Virginia, Southeast U. S., Statistics, Data collections, Creel census.

A survey of the sport fishery was conducted in a 265-square-mile area of the lower Potomac Estuary during the summer and fall of 1959, 1960, and 1961. Fisherman interviews, postal card questionnaires, and aerial boat counts were used to determine angling pressure, rates of catch, estimated harvest, species importance, and economic value of the sport fishery. The 1961 estimate indicated that 101,000 angler trips produced approximately 1,200,000 fish weighing almost 642,000 pounds. Party size averaged 3.0 anglers who fished approximately 4.5 hours per trip and creeled 2.6 fish per man-hour. During the five-month survey in 1961, an estimated $594,000 was spent by Potomac Estuary anglers. The average angler spent $5.80 on each of his 29 mean yearly trips.
W69-04992

THE FISHERIES--A NEGLECTED ASPECT OF ESTUARINE RESEARCH,
William H. Massmann.
29th North American Wildlife and Natural Resources Conference, Transactions, March 9-10, 1964, pp 337-352.

Descriptors: *Sport fish, *Fish management, *Environmental effects, *Estuarine fisheries, Life history studies, Management, Fisheries, Fish hatcheries, Ecology, Animals, Aquatic animals, Aquatic life, Fish, Wildlife.

The author states that the bulk of marine sport fish of the Atlantic and Gulf coasts are dependent on estuaries for either spawning, nursery, or feeding grounds, but there has been little research on the management of estuarine fishes. Striped bass and Atlantic shad research has uncovered basic information, but most questions regarding management remained unanswered. Further detailed life history, ecological and behavior studies, information on fish population dynamics are needed for important estuarine dependent coastal fishes (flounders, weakfish, spotted seatrout and others). Information is also needed on effects of environmental factors and engineering structures on fish populations. Basic studies on the fishes in estuaries should ultimately result in methods for minimizing or compensating for damage to these waters. The use of artificial reefs by sport fishes needs to be clearly evaluated. Catch regulations, where needed, should be based on the results of biological studies, and their effects should be thoroughly evaluated.
W69-05025

HORIZONTAL DIFFUSION FROM AN INSTANTANEOUS POINT SOURCE DUE TO OCEANIC TURBULENCE,
A. Okubo.
Chesapeake Bay Institute, Johns Hopkins University, Baltimore, Maryland, Report No 32, 1962.

Descriptors: *Diffusion, *Ocean circulation, *Turbulence, Mathematical models, Eddies, Circulation, Movement, Energy, Water circulation, Mathematical studies, Model studies, Currents (Water), Turbulent flow, Flow.

In this paper the author discusses horizontal turbulent diffusion of a patch of a diffusive substance released from an instantaneous point-source in the sea. In Part I, a systematic derivation of some proposed concentration distributions for a patch is developed on the basis of a non-Markov hypothesis combined with knowledge of the rate of mean square dispersion. A new proposal for the concentration distribution is also presented. The solutions of others are critically discussed in comparison with available information about horizontal diffusion in the sea. In Part II, a re-examination is made of the relations between the variance of the distribution and diffusion time and between the coefficient of eddy diffusion and the scale of the phenomenon, using accumulated data. In addition to this, some speculation about the two-dimensional horizontal energy spectrum of oceanic turbulence is presented.
W69-05036

A REVIEW OF THEORETICAL MODELS OF TURBULENT DIFFUSION IN THE SEA,
A. Okubo.
Chesapeake Bay Institute, Johns Hopkins University, Baltimore, Maryland, Report No 30, 1962.

Descriptors: *Mathematical models, *Diffusion, *Turbulence, *Ocean circulation, Mixing, Dye releases, Turbidity currents, Radioactivity, Stratification, Water circulation, Mathematical studies, Model studies, Analytical techniques, Currents (Water), Density currents, Circulation, Movement.

A comprehensive survey of theoretical models for turbulent diffusion in the sea is presented. In the introductory sections, the author describes results of some recent observations of turbulent structure in the sea and points out some fundamental concepts which are necessary for the treatment of turbulent diffusion in the sea. Material presented in later sections falls into two parts: (1) Some of the important statistical properties associated with particle displacement in a turbulent velocity field are discussed without having information about the probability distribution functions. (2) A systematic derivation of some proposed concentration distributions for a patch of diffusive substance is shown on the basis of a non-Markov hypothesis combined with a knowledge of the rate of mean dispersion. Also some theoretical models for the mean concentration of substance released from a continuous fixed source are presented in comparison with available information. In addition to these, the author reviews briefly an empirical approach to the general problem of turbulent diffusion in the sea, where the dependence of the vertical coefficient of diffusion on the stratification of water is emphasized.
W69-05037

INSHORE MARINE CONSERVATION,
Carleton Ray.
First World Conference on National Parks, National Park Service, Department of the Interior, Washington, D. C., June 30-July 7, 1962, pp 77-87.

Descriptors: *Aquatic habitats, *Fish conservation, *Soil conservation, *Water conservation, *Regulation, Parks, Water resources development, Fish management, Conservation, Commercial fishing, Management.

The major theme in this paper is a proposal to project the ideas and support of land and fresh water conservation to the marine environment. This would necessitate the establishment of: (1) parks, (2) sanctuaries for research and study, (3) management programs, and (4) regulations and enforcement. To support his contention, the author cites five illustrative points: (1) The sea has productive and desert areas. Inshore areas are most productive. (2) The sea has been utilized with replenishment (by man) for centuries. (3) Commercial fishing can be decimated in productive inshore areas. (4) There is limited knowledge of the marine environment. (5) The sea is a three dimensional environment with three atmospheres to protect.
W69-05044

PRECONSTRUCTION STUDY OF THE FISHERIES OF THE ESTUARINE AREAS TRAVERSED BY THE MISSISSIPPI RIVER-GULF OUTLET PROJECT,
G. A. Rounsefell.
Fishery Bulletin, U. S. Fish and Wildlife Service, Vol 63, No 2, 1964, pp 373-393.

Descriptors: *Construction, *Channels, *Mississippi River, *Louisiana, *Commercial shellfish, Saline water systems, Salt marshes, Gulf of Mexico, Estuarine fisheries, Oysters, Commercial fishing, Crabs, Coastal plains, Geographical regions, Gulf coastal plain, Regions, Southeast U. S., Fishing, Industries, Bodies of water, Interstate rivers, Rivers, Running waters, Streams, Surface waters, Marshes, Wetlands, Gulfs, Animals, Aquatic animals, Aquatic life, Invertebrates, Shellfish.

The author speculates that the construction of the deep water navigation channel from New Orleans to the Gulf of Mexico would cause a rise in salinity that could adversely affect the commercial blue crab and oyster populations. Blue crab larvae spend time in low saline marsh areas, while the higher salinities on the oyster beds may permit the intrusion of the oyster drill, a serious predator.
W69-05049

REALISM IN THE MANAGEMENT OF ESTUARIES,
Alabama Marine Resources Lab., Dauphin Island.
G. A. Rounsefell.
Report No. 1, December, 1963.

Descriptors: *Management, *Fish management, *Ecology, Food chains, Fisheries, Statistics, Data collections, Estuarine fisheries, Biological communities.

The author maintains that estuaries are vital because they are nursery areas for many species. He feels that the productivity of estuaries is being endangered by unrealistic recommendations that do not deal with the entire estuarine system. Some interesting statistics derived from other sources are quoted as are the findings of a number of biological studies illustrating the complexities of estuarine systems.
W69-05050

THE SEDIMENTS OF CHESAPEAKE BAY,
J. Donald Ryan.
Maryland Board of Natural Resources, Department of Geology, Mines, and Water Resources, Bulletin No. 12, 1963.

Descriptors: *Sedimentation, *Sediments, *Oysters, *Maryland, Sedimentation rates, Sediment distribution, Rates, Animals, Aquatic animals, Aquatic life, Benthic fauna, Benthos, Commercial shellfish, Invertebrates, Marine animals, Mollusks, Shellfish, Appalachian Mountain region, Atlantic coastal plain, Coastal plains, Geographical regions, Regions, Northeast U. S., Bays, Bodies of water.

The results of research to determine the physical characteristics and origins of Chesapeake Bay sediments are reported. Methods of study and descriptions of samples, geologic and physiographic characteristics, hydrographic considerations, erosion rates and sources, oyster distribution, and mineralogy of the sediments are discussed. Maps of sediments are shown. The objective of the study was, 'to determine the mechanism of siltation in Chesapeake Bay', and did not include study of the effects of siltation upon oyster production. However, the report states '...the oyster beds are restricted to the sandy areas of the bay bottom where silt and clay are practically absent. Most of the large areas of sand bottom within the bay include extensive areas where oysters breed....the absence of oyster bars in channel muds is probably due more to the poor environment than to the silt and clay-size particles. Similar toxic conditions are not present in the favored areas of shallow water and sand bottom. It does not seem likely, therefore, that a mere increase in quantity of the fine material in suspension would have much of an adverse effect on the oyster crop. Rapid encroachment of mud over oyster bars might cause gradual readjustment in the location of the bars, but no such encroachment was observed in this investigation.'
W69-05052

SHORELINE RECREATION RESOURCES OF THE UNITED STATES.
George Washington University for the Outdoor Recreation Resources Review Commission (ORRRC), Report No. 4, 1962.

Descriptors: *Recreation facilities, *Water pollution control, *Erosion control, *Shores, Beaches, Parks, Control.

The report inventories existing coastal recreation facilities. Accessibility and availability are characterized as the two important recreation area targets. Shoreline areas are considered highly accessible if they are within 30 miles, or one hour driving time, of a metropolitan area of 500,000 or more. Recreation shoreline is defined as: (1) having a marine climate and environment, (2) having an expanse of view over water of at least five miles, and (3) being located on a water boundary. This definition excludes many estuarine shoreline recreation sites. Inventories of shoreline recreation areas are designated by coast, state, type (beach, bluff, or marsh), ownership, and degree of development. Appendix B discusses, by state, general features of shoreline recreation areas, administration, water pollution control, erosion control, tidelands ownership and access, and the status of recreation planning.
W69-05054

MULTIPLE UTILIZATION OF GULF COAST ESTUARIES,
J. E. Sykes.
17th Annual Conference, Southeastern Association of Game and Fish Commissioners, 1963, pp 323-326.

Descriptors: *Estuarine fisheries, *Productivity, *Gulf of Mexico, Commercial fishing, Commercial shellfish, Multiple purpose, Fisheries, Animals, Aquatic animals, Aquatic life, Invertebrates, Shellfish, Fishing, Industries, Bodies of water, Gulfs, Surface waters, Coasts, Beneficial use.

It is estimated that some 7500 square miles or 4,800,000 acres of estuarine area exist on the periphery of the Gulf of Mexico. Gulf commercial catches of fish and shellfish in 1960 consisted of over one billion pounds of estuarine dependent species. The contribution of Gulf estuaries toward these catches amounted to approximately 230 pounds per acre. The evaluation of estuaries is discussed in terms of total production including other forms of organic matter. Beneficial and detrimental uses of shallow-water coastal areas are cited.
W69-05057

WHAT IS HAPPENING TO OUR ESTUARIES,
For primary bibliographic entry see Field 06B.
W69-05060

THE DIFFERENTIATION, ANALYSIS, AND PRESERVATION OF NITROGEN AND PHOSPHORUS FORMS IN NATURAL WATERS,
California Univ., Berkeley. Sanitary Engineering Research Lab.
For primary bibliographic entry see Field 05A.
W69-05137

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

HIGH-CAPACITY DUAL-PURPOSE PLANT FOR GENERATING ELECTRICITY AND PRODUCING FRESH WATER FROM SEA WATER,
Commissariat a l'Energie Atomique, Paris (France).
P. Balligand, J. Huyghe, M. d'Orival, and P. Vignet.

For the 8 Volume Proceedings, see Vol 2, No 9, Field 06B, W69-03305. Int Conf on Water for Peace, Wash, D C, Vol 2, pp 146-157, 1968. 12 p, 7 fig, 1 tab, 2 ref.

Descriptors: *Nuclear powerplants, *Desalination plants, *Electric generators, *Cost comparisons, Distillation, Comparative costs, Sea water, Fresh water.
Identifiers: France, Kestner process, Electric generating plant.

The combination of a plant for desalting sea water by distillation with a power-generating 500 MW nuclear reactor of the natural uranium-graphite-carbon dioxide type, using the French system is discussed for the process of successive expansions (H.S.F.) or of the Kestner process (L.T.V.). If distillation facilities are joined to each of the 2 turbo-alternator units of the reactor, the production of fresh water becomes about 500,000 cu m per day for a net electric power of 250 to 300 MW available to the system and the auxiliary units of the water plant; however, the generating plant must operate as the primary unit. If a single turbo-alternator unit is equipped with a distillation facility, the ratio of the production of water to the production of electricity is lower, but the operation of the electric generating plant can be more flexible. The effect of the main parameters on the cost of the water, ratio of the production of electricity to that of water, conditions pertaining to financial investments, cost of steam, cost of water, depreciation and charges are given. Several development studies which would be necessary to continue this preliminary project are cited. (Vorhis-USGS)
W69-04754

DEVELOPMENT OF A LOW-COST IRON-BASE ALLOY TO RESIST CORROSION IN HOT SEA WATER,
Westinghouse Electric Corp., Pittsburgh, Pa.
N. Pessall, F. C. Hull, N. Michael, and C. Liu.
Office Saline Water Res and Develop Progr Rep No 394, Jan 1969. 79 p, 30 fig, 7 tab, 27 ref, 1 append. OSW Contract No. 14-01-0001-1447.

Descriptors: *Corrosion, *Desalination, *Sea water, *Material testing, Evaluation, Economics, Electrochemistry, Deaeration, Model studies, Methodology.
Identifiers: *Iron-base alloys, *Potentiostatic techniques, High-temperature test loop.

Observations made during the first phase of basic research aimed primarily at seeking a low-cost iron-base alloy to resist corrosion in hot sea water are summarized. Alloys, test conditions, corrosion weight losses, corrosion rates, and other data are listed in tables and experimental procedures are described and conclusions presented. Dynamic loop tests at 250 deg F in deaerated sea water, and studies of anodic polarization curves made at room temperature in deaerated 0.IN NaCl solution, were used to evaluate relative corrosion behavior of alloys. Minimal effects were indicated of melting practice, processing procedures, and crystallographic texture on the corrosion of iron-base alloys in hot sea water. Based on the observations of synergietic alloying effects in Fe-Cr and Fe-Al alloys, future development of corrosion resistant iron-base alloys probably will be centered on multicomponent single phase alloys containing chromium and/or aluminum as major alloying components. Beneficial effects as alloying elements were shown by additions of Co, Mo, Ni, Nb, Si, W, Ag, Zr, V, and Ti. The electrochemical method is preferred for evaluation of new iron-base alloy compositions. (Lang-USGS)
W69-04771

PROSPECTS OF DESALINATION FOR SOLVING WATER PROBLEMS ON THE MAKRAN COAST,
Pakistan Atomic Energy Commission, Karachi.
Ismat Kamal.
For the 8 Volume Proceedings, see Vol 2, No 9, Field 06B W69-03305. Int Conf on Water for Peace, Wash, D C, Vol 6, pp 782-790, 1968. 9 p, 2 fig, 1 tab, 4 ref.

Descriptors: *Desalination, *Nuclear powerplants, *Water sources, *Arid lands, Coasts, Water resources development, Reclamation, Land reclamation, Irrigation.
Identifiers: Baluchistan (Pakistan), Makran Coast (Pakistan).

Basic facts on Pakistan are given with particular reference to West Pakistan and the areas of the former Baluchistan province, and the effect of the absence of water supplies in hampering development of the area and in causing soil erosion. There is archaelogical evidence to show that in ancient times Baluchistan was a well irrigated and cultivated area - 'the desert in Baluchistan is largely man-made'. Desalination of sea water can be applied to solve the problems of 2 of the 7 physiographic regions of Baluchistan which lie on the Arabian Sea Coast. These are the southern Coastal Sub-Region, occupied by the lower valleys of the Porali, the Kharari and the Windar, with the fishing port of Sonmiani as a potential site, and the Makran Coastal Sub-Region, with the fishing ports of Gwadar, Jiwani and Pasni as potential sites. The geographical features of these regions are described with reference to their importance in absorbing the overflow of population from the Indus Basin and the Karachi area, and providing sites for 1 or 2 additional ports to relieve the present congestion at Karachi harbour. A nuclear power and desalination plant on the Makran Coast must be applied not only for improving the existing fish and date processing industries (which will provide valuable foreign exchange) but must also be accompanied by an overall industrial and, possibly, agricultural development of the area. The existing natural water resources of the area and the extent to which they can be exploited are described. Most of the rivers of the area under discussion are dry for the greater part of the year and the sea, if properly exploited, can be the only permanent and reliable source of fresh water. A dual-purpose plant on the Makran Coast is discussed with reference to existing and future cost economics and the use to which the incumbent electricity supply can be put. (Knapp-USGS)
W69-04776

COST PROJECTIONS FOR LARGE DESALTING SYSTEMS WITH VARIOUS TYPES OF COUPLING,
I. Spiewak, and R. A. Ebel.
For 8 volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 2, pp 296-303, 1968. Washington, D C: U S Government Printing Office, 8 p, 4 fig, 1 tab, 13 ref.

Descriptors: *Desalination plants, Electricity, Nuclear reactors, Costs, Nuclear energy, Water costs, Evaporators.
Identifiers: *Cost projection, *Coupling, Dual plants, Nuclear plants, Surplus power, Nuclear power costs.

This paper discusses cost projections for large nuclear steam plants which are suited to the production of electric power or to the production of water in dual-purpose power-and-desalting plants. These types of nuclear power plants are under active development in the United States and Europe. Cost projections for coupled evaporators are derived from studies sponsored by the Office of Saline Water. The dual-purpose power-desalting plant provides desalted water at the lowest cost based on present concepts. The amount of surplus power may be so large that it cannot be marketed in all cases. This paper, therefore, explores methods of coupling nuclear plants and evaporators so as to reduce or eliminate the surplus power. (Loeb-Rutgers)
W69-04814

COST REDUCTION IN DESALTING SEA WATER,
O. B. Waters, Jr., M. C. Uy, A. J. Weinberger, and D. F. De Lapp.
For 8 Volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 2, pp 305-314, 1968. Washington, D C : U S Government Printing Office.

Descriptors: *Sea water, *Costs, *Desalination, Descaling.
Identifiers: *Cost reduction, Mineral by-products, W R Grace and Co, American Cyanamid Co.

Descaling of raw sea water and recovery of mineral by-products as a part of desalination may offer ways to reduce the overall cost of obtaining fresh water from the seas. This paper discusses work done on both these possibilities by two American Chemical companies under contract with the Office of Saline Water, U S Department of the Interior. As such, a lime-magnesium carbonate pretreatment process developed at W R Grace and Co is discussed as well as a feasibility study by investigators at the American Cyanamid Co. The latter has yielded two processes which could combine recovery of economically valuable chemical by-products with recovery of fresh water from the sea. The value of the by-products may, under certain conditions, be enough to reduce the overall cost of purifying the water. This latter paper outlines mineral values worth recovering and presents two processes proposed for by-product recovery as a part of sea water desalting. The advantages, limitations, and projected economics (under U S conditions) of these processes are discussed. (Loeb-Rutgers)
W69-04826

ANALYSIS OF THE COST OF WATER TRANSMISSION BY PIPELINE,
C. C. Burwell.
For 8 Volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 3, pp 171-181, 1968. Washington, D C: U S Government Printing Office.

Descriptors: *Pipelines, *Desalination, *Water costs, *Water transfer, Forecasting, Nuclear energy, Costs, Water supply.
Identifiers: *Water transmission costs, *Water transmission, Power cost, Optimum pipeline diameter, Pipeline capacity, Rate of return, Cost projections.

Low cost projections for desalination depend upon low cost nuclear energy. Water transmission costs are also affected by energy costs, in that the cost of pumping power to overcome drag and to elevate water is a function of power cost and in that the optimum pipeline diameter (and therefore its installation cost) for a given water capacity decreases as power costs decrease. A correlation of the installed cost of pipelines as a function of pipeline diameter is used to develop an analytical expression that predicts the optimum pipe diameter as a function of pipeline capacity, power cost, and rate of return on the capital investment. The pipeline diameter cor-

relation is then used to predict the unit cost of water conveyance over a wide range of parameters, to determine the sensitivity of water cost to variations in a given parameter and to illustrate the relationship of conveyance costs to total water cost for particular examples. (Loeb-Rutgers)
W69-04827

GIBBS PHASE RULE AND MARINE SEDIMENTS,
Royal Inst. of Tech., Stockholm (Sweden).
For primary bibliographic entry see Field 02K.
W69-04964

COORDINATION CHEMISTRY OF THE OCEANS,
University of South Florida, Tampa.
For primary bibliographic entry see Field 02K.
W69-04971

DESALINIZATION AND FUTURE WATER SUPPLY IN THE UNITED STATES,
R. J. Faust.
American Water Works Association, Journal, Vol 54, No 5, May, 1962, pp 519-529.

Descriptors: *Desalination, *Water sources, *Reclaimed water, *Water supply, Demineralization, Separation techniques, Water purification, Water treatment, Supply.

Desalinization is discussed as one alternative to providing fresh water supplies in the United States. The article concludes that except for isolated cases, there is plenty of water. A distribution problem exists, but the main concern is to use present resources wisely. The reuse of treated sewage in Baltimore, Maryland, by Bethlehem Steel for industrial purposes is proposed as an example of wise water use.
W69-04988

ECONOMIC ASPECTS OF SALINE-WATER CONVERSION,
James C. Lamb, III.
American Water Works Association, Journal, Vol 54, No 7, July, 1962, pp 781-788.

Descriptors: *Desalination, *Economic feasibility, *Distillation, *Electrodialysis, *Brackish water, Costs, Feasibility, Demineralization, Separation techniques, Water purification, Water treatment, Dialysis, Membrane processes, Saline water, Water types.

The purpose of this paper is to review the basis for costs which have been presented for both conventionally treated and desalted water supplies and to discuss several factors which must be considered in any definite comparison of these costs. Among the points noted by the author are the following: (1) Cost of desalting by distillation is not greatly affected by concentration of salts. On the other hand, electrodialysis and several other processes are affected by concentration. These processes seem particularly suited to desalting brackish waters. (2) The only practical way of comparing desalination costs to the costs of other fresh water sources is on the basis of the cost on an additional increment of fresh water added at a specific location, both estimates to include all times of expense. (3) Desalting may play an important role on a local level, but it is not anticipated that saline-water conversion will supplement national water resources to a significant degree in the foreseeable future.
W69-05017

OUTLOOK FOR ECONOMIC USE OF FRESH WATER FROM THE SEA,
S. B. Morris.
Journal of the Irrigation and Drainage Division, June, 1961, pp 15-26.

Descriptors: *Economic feasibility, *Desalination, *Texas, Central U. S., Coastal plains, Geographical regions, Gulf coastal plain, Regions, Southwest U. S., Feasibility, Demineralization, Separation techniques, Water purification, Water treatment.

The prospects for desalination systems in the United States are analyzed. The author is pessimistic except in special instances and along the Texas Gulf Coast.
W69-05032

DEVELOPMENT OF TRANSPORT DEPLETION PROCESSES,
Southern Research Inst., Birmingham, Ala.
Everett L. Huffman.
Office of Saline Water R and D Report No 439, 1969. 104 p. OSW 14-01-0001-698.

Descriptors: *Desalination, *Transport depletion, *Electrodialysis, *Membrane processes, Energy, Brackish water, Scaling, Calcium sulfate, Bicarbonates, Costs, Efficiencies.
Identifiers: *Neutral membranes, Current density, Solution velocity.

The transport depletion variant of electrodialysis in which a near-neutral membrane replaces the anion-selective membrane was investigated for demineralizing both natural and synthetic brackish waters. When waters containing pH sensitive salts were demineralized, current densities up to and well above the economic optimum current density could be used without encountering the polarization-induced precipitation problems normally associated with conventional electrodialysis. With a high-sulfate water, on the other hand, the problems of calcium sulfate precipitation at high waste stream concentrations were similar for both transport depletion and conventional electrodialysis. Due to the fact that the near-neutral membranes used in the transport depletion experiments became cation-selective in dilute solutions, the current efficiencies ranged from 60 to 95% of that theoretically attainable. The properties of the near-neutral membrane also controlled the relative energy requirements of transport depletion, making them range from 63 to 110% of those for conventional electrodialysis with the same product flow rate per diluting compartment. Even with these membranes, however, overall demineralization costs with transport depletion with some waters will be lower than those for conventional electrodialysis. (Mintz-OSW)
W69-05156

SYNTHESIS AND EVALUATION OF NEW MEMBRANE CANDIDATES FOR APPLICATION IN REVERSE OSMOSIS,
Peninsular Chem Research, Gainesville, Fla.
Thomas W. Brooks, and Carl L. Daffin.
Office of Saline Water Research and Development Progress Report No. 385, Jan 1969, 40 p. OSW 14-01-0001-1260.

Descriptors: *Reverse osmosis, *Semipermeable membranes, Desalination, Desalination processes, Demineralization, Membranes, Permselective membranes, Osmosis, Films, Membrane processes, Plastics, Thin films.
Identifiers: Block copolymers, Graft copolymers.

Block copolymers were synthesized from peroxycarbamate-terminated poly (ethylene oxide) and the vinyl monomers styrene, methyl methacrylate, and acrylonitrile. Transport coefficients were determined for membranes fabricated from these block copolymers and it appears that they are relatively insensitive to the structure of the hydrophobic cosegments. The morphology of the poly (ethylene oxide) phase in these block copolymers was found to be an important factor insofar as water permeability is concerned. A substantial increase in the crystallinity of the poly (ethylene oxide) phase, which can be detected calorimetrically, is accompanied by a substantial decrease in water permeability. Compaction of a PEO/styrene block copolymer membrane during testing under reverse osmosis conditions resulted in a significant increase in selectivity with only a slight decrease in water permeability. These membranes, even after compaction, are one to two orders of magnitude faster than dense cellulose acetate membranes. Preliminary studies on styrene grafted syndiotactic poly (vinyl alcohol) films indicate that membranes of this type are at least as water permeable as cellulose acetate, although much less selective. The Kedem-Katchalsky system for evaluating permselective membranes, which is based on the theories of non-equilibrium thermodynamics, has been found to be most useful as a guide in evaluation studies. (Kindley-OSW)
W69-05157

3B. Water Yield Improvement

WEATHER MODIFICATION, PRESENT AND FUTURE,
Travelers Insurance Co, Hartford, Conn.
Thomas F. Malone.
J Amer Water Works Ass, Vol 60, No 10, pp 1143-1148, Oct 1968. 6 p.

Descriptors: *Weather modification, *Weather, Atmosphere, Winds, Atmospheric precipitation, Temperature, *Energy conversion, *Effects, Energy, Storms, Storm structure, Mathematical models, Meteorology, Simulation analysis, Social impact, Forecasting, Cloud seeding, Legal aspects, Artificial precipitation.
Identifiers: Weather effect, Atmospheric research.

The atmosphere is a complex physical system where movement of air, change in temperature, and transformation of water among liquid, solid, and gaseous phases are taking place in response to certain forces and through particular processes. The quantities of energy involved in weather systems and processes occurring naturally in the atmosphere substantially exceed the quantities of energy under the control of man. Two characteristics of the atmosphere keep the outlook on weather modification from being pessimistic: (1) an intrinsic tendency toward certain instabilities and (2) the key role of the processes at the interface between the atmosphere and the underlying surface in determining energy inputs into the atmosphere. Four scientific and technologic developments suggesting new horizons of research are given. The present state of the art is summarized. Related problems that may arise because of weather modification are discussed. (USBR)
W69-04717

WATER HOLDING CAPACITY OF PONDEROSA PINE FOREST FLOOR LAYERS,
Forest Service (USDA), Flagstaff, Ariz. Rocky Mountain Forest and Range Experiment Station.
Warren P. Clary, and Peter F. Ffolliott.
J Soil and Water Conserv, Vol 24, No 1, pp 22-23, Jan-Feb 1969. 2 p, 1 fig, 1 tab, 11 ref.

Descriptors: *Forest soils, *Infiltration, *Storage, Runoff, Humus, Soil water movement, Rainfall-runoff relationships, Forest management, Soil management, Excess water (Soils), Water conservation, Water yield.
Identifiers: *Water retention.

The retention of water by 3 undisturbed forest floor layers was studied in an Arizona ponderosa pine forest. The 3 layers are the L layer of unaltered organic matter, the F layer of partly decomposed organic matter, and the H layer of well decomposed organic matter. In the Beaver Creek watershed study area, north-central Arizona, the annual precipitation is 24 inches. Soils are developed from basaltic volcanic materials and surface materials are clay loams. At each test location a 1 ft sq sample was isolated by pushing a metal frame through the surface. About 4 gal of water was added, the surface was sealed to prevent evaporation, and the frame was left in place 24 hr for drainage. The individual layers were then weighed immediately,

and after 24 hr drying at 105 deg c. Average water retained in the L layer was 0.003 in., in the F layer, .010 in., and in the H layer, .075 in. It is estimated that 1 in. of forest floor will hold 0.05 in. water, and each additional in. of floor material will hold 0.07 in. of water. To reduce the ability of forest floors to hold water in a runoff-increasing program, the H layer must be removed or modified; the feasibility of this is not presently known. (Knapp-USGS)
W69-04751

AREAL SPREAD OF THE EFFECT OF CLOUD SEEDING AT THE WHITETOP EXPERIMENT,
California Univ., Berkeley. Dept. of Statistics.
Jerzy Neyman, Elizabeth Scott, and Jerome A. Smith.
Science, Vol 163, No 3874, pp 1445-1448, Mar 1969. 4 p, 3 fig, 2 tab, 19 ref.

Descriptors: *Cloud seeding, *Statistics, Halides, Condensation, Evaporation, Weather modification, Nucleation, Rain, Rainfall, Silver iodide, Artificial precipitation, Missouri, Arkansas, Synoptic analysis.
Identifiers: Whitetop Cloud-Seeding Experiment.

With reference to arguments that weather modification technology is sufficiently advanced for the federal government to finance cloud-seeding operations as a means of alleviating water shortages, an analysis of the Whitetop rain stimulation experiment was performed. The average 24-hour precipitation in 6 concentric regions up to 180 mi from the center of the target on 102 days of cloud seeding was less than that on the 96 experimental days without seeding. For distances less than 30 mi, the apparent loss of rain due to seeding was 32%. With the increase in distance, this apparent loss decreased to a minimum of 9% for gages between 120 and 150 mi from the center. However, the 48 gages at distances between 150 and 180 mi showed a 22% apparent loss of rain due to seeding. The estimated average loss of rain within the whole region of about 100,000 sq mi was 21% of what would have fallen without seeding. When a 5-yr experiment, expected to produce a 5 to 10% increase, shows a 20% decrease in rainfall, the relevant technology does not appear reliable enough for practical use. (Knapp-USGS)
W69-04775

ECONOMICS AND THE CONSERVATION QUESTION,
Carleton Univ., Ottawa (Ontario).
Gordon Scott.
Journal of Law and Economics, Vol 1, pp 110-121, Oct 1958. 12 p.

Descriptors: *Natural resources, *Conservation, Monopoly.
Identifiers: *Capital investment, *Time distribution, Depletion, Fixed resources, Social costs, Social benefits, Ocean fisheries.

The most distinct conclusion for policy that seems to emerge from an analysis of the conservation problem is that very little governmental interference of an explicitly conservationist nature is called for. Better results would appear to follow from activities designed to correct the institutional defects, so that the private decisions of resource users are more likely to approximate the social ideal. Such institutional developments are not easy to bring about, but they are more fundamental, and give promise of more enduring and satisfactory solutions. Insofar as considerable misuse of natural resources stems from scientific and technical ignorance, the only remedial policy would seem to lie in efforts to increase our knowledge of both theoretical and applied science. The problem of 'shortsightedness' of small producers due to inability to borrow on or liquidate resource assets at satisfactory prices is one which can be solved by greater development of the markets for capital funds and for certain commodities. It is the common property problem and the divergence between private and social costs and benefits that seem to be most worthy of the application of administrative and legal ingenuity. And it seems we are destined to attempt to devise such solutions first in the case which is probably the most difficult-ocean fisheries. Water developments at times conflict with conservation issues and this article is relevant to clarifying the economic problems involving both interests. (Sokoloff-Rutgers)
W69-04841

NET, ALLWAVE RADIATION AS AN INDEX OF NATURAL SNOWMELT AND SNOWMELT ACCELERATED WITH ALBEDO REDUCING MATERIALS,
Forest Service (USDA), Boise, Idaho. Intermountain Forest and Range Experiment Station.
For primary bibliographic entry see Field 02C.
W69-05103

3C. Use of Water of Impaired Quality

COOLING WITH SEAWATER,
G. Heinemann.
Chemical Engineering, Vol 70, No 12, June 10, 1963, pp 188-189.

Descriptors: *Cooling, *Sea water, *Chlorination, Cooling water, Saline water, Water types, Chemical reactions, Tidal waters.

It is expected that the use of sea water for cooling should increase as the supply of fresh water becomes more and more limited. This article discusses materials for use in systems using sea water and water from tidal basins. The use of chlorine to prevent the growth of organisms in these systems is also discussed.
W69-04999

FACTORS AFFECTING BIOLOGICAL CLOGGING OF SAND ASSOCIATED WITH GROUND WATER RECHARGE,
Weizmann Inst. of Science, Rehovoth (Israel).
Z. Nevo, and R. Mitchell.
Water Research, Vol 1, No 3, pp 231-236, March 1967. 3 fig, 9 ref.

Descriptors: *Groundwater recharge, *Sands, *Degradation (Decomposition), *Soil microorganisms, *Rice, Microorganisms, Aerobic bacteria, Reclaimed water, Infiltration, Ponds, Waste water treatment, Environmental sanitation, Flooding, Hydrogen ion concentration, Microbiology, Water temperature, Percolation, Oxidation-reduction potential.
Identifiers: *Clogging, *Polysaccharides, Israel, Potential.

A major problem associated with ground water recharge is biological clogging of sand. Studies were conducted in Israel to obtain precise information concerning effects of environmental conditions on processes underlying clogging and reopening of sand beds. During flooding of waste water, clogging of sand beds by microbial polysaccharides appeared to be correlated with a decline in measured potential in the sand, which inhibited degradation of the polysaccharides. Periodic resting of infiltration ponds was found to be effective in unclogging sand beds, presumably by stimulating aerobic polysaccharide decomposition. Growth of paddy rice, which exudes oxygen from its roots, was found to be an effective means of keeping sand beds oxidized. It was suggested that pH adjustment could also be used to prevent polysaccharide accumulation. A correlation between water temperature and clogging was observed. (Affleck-Arizona)
W69-05075

3D. Conservation in Domestic and Municipal Use

PUBLIC PARKS - PLAYGROUNDS.
For primary bibliographic entry see Field 06E.
W69-04878

3E. Conservation in Industry

REPORT ON THE 1961 TRANSPORTATION RESEARCH AND SERVICE ACTIVITIES OF THE BUREAU OF COMMERCIAL FISHERIES,
Carl P. Hoffman, Jr., and Donald S. Fitzgibbon.
Branch of Economics, Bureau of Commercial Fisheries, Washington, D. C., Report No. 544, June, 1962.

Descriptors: *Transportation, *Commercial fishing, *Federal government, Fishing, Industries, Data collections, Statistics, Financial analysis, Analytical techniques, Commercial fish, Animals, Aquatic animals, Aquatic life, Fish, Wildlife, Commercial shellfish, Invertebrates, Shellfish, Costs, Regulation, Negotiations, Storage.

The activities reported upon include (1) participation in regulatory proceedings and (2) negotiations with carriers to obtain improvements in transportation rates, services, and facilities for the fishing industry. The research activities of the Transportation Section involve collection and analysis of financial and traffic data and study of the methods used in moving, terminal handling, packing, and storing of fish and shellfish. The work is carried on by the Transportation Section staff, by other Government agencies, and by private firms working under contract.
W69-05001

COMMERCIAL AND SPORT FISHERIES,
Interstate Commission on the Potomac River Basin, Washington, D. C.
Edgar H. Hollis.
In PROBLEMS OF THE POTOMAC ESTUARY, January, 1964, pp 23-27.

Descriptors: *Maryland, *Virginia, *Sport fishing, *Commercial fishing, *Productivity, Personnel, Market value, Appalachian Mountain region, Atlantic coastal plain, Coastal plains, Geographical regions, Northeast U. S., Regions, Commercial shellfish, Crustaceans, Invertebrates, Fish, Shellfish, Wildlife, Southeast U. S., Statistics, Data collections, Crabs, Finfish, Fishing, Industries, Recreation, Water sports, Animals, Aquatic animals, Aquatic life.

A general discussion of the fisheries of the Potomac Estuary is presented. The report contains estimates of the production capability of commercial fisheries, their value to the Potomac River and its tributaries during recent years, and estimates of the number of people participating in the commercial fishery. Estimates of sport fishing usage and catch based on surveys conducted in 1960 and 1961 by the Natural Resources Institute are given. It concludes that the commercial production of crabs and finfish in the Potomac Estuary is of a sizeable magnitude and in all probability can be maintained at the existing or at a slightly increased level for a long period of time. However, because of the economic conditions and trends generally prevailing in the inshore fishing industry, prospects for increasing the production and values for commercial species in the Potomac Estuary do not appear as great as for the other resources.
W69-05002

3F. Conservation in Agriculture

A CLIMATOLOGICAL-TECHNOLOGICAL METHOD FOR ESTIMATING IRRIGATION

WATER REQUIREMENTS FOR MAXIMUM CROP YIELDS,
Illinois State Water Survey, Urbana.
Stanley A. Changnon, Jr.
J Soil and Water Conserv, Vol 24, No 1, pp 12-15, Jan-Feb 1969. 4 p, 1 photo, 4 tab, 13 ref.

Descriptors: *Irrigation efficiency, *Irrigation water, *Crop production, Crop response, Regression analysis, Forecasting, Irrigation practices, Supplemental irrigation, Illinois, Consumptive use, Evapotranspiration, Climates, Weather, Rainfall, Temperature.
Identifiers: Irrigation water requirements.

A method is given for estimating irrigation water requirements, using regression analysis of weather and crop production data including preseason precipitation, monthly mean temperatures, and monthly precipitation. The data used are from Illinois for the period 1930-1963. The results of analysis are tabulated for the 12 regional subdivisions of Illinois in terms of % increase of yield, weather types, July-August conditions, and frequency of yield increase for given amounts of irrigation water. The frequency information is accurate enough to use in planning irrigation water supplies anywhere historical climate and yield data are available. (Knapp-USGS)
W69-04750

POPULATION, GROWTH RATE, AND MATURITY OF VEGETABLE CROPS IN RELATION TO SOIL SALINITY AND TEXTURE UNDER SPRINKLER AND FURROW IRRIGATION,
California Univ., Davis. Dept. of Water Science and Engineering; California Univ., Riverside.
For primary bibliographic entry see Field 021.
W69-05074

HYDROLOGIC MINI-CYCLE FOR SOIL MOISTURE AND SALT CONTROL IN IRRIGATED AGRICULTURE,
California Univ., Davis. Dept. of Water Science and Engineering.
Robert J. Miller.
Calif Agr, Vol 23, No 1, pp 8-11, Jan 1969. 3 fig.

Descriptors: *Soil moisture, *Salts, *Hydrologic cycle, *Solar distillation, *Plastics, Irrigation efficiency, Furrow irrigation, Moisture content, Evapotranspiration control, Evaporation control, Soil surfaces, Soil temperature, Cycles, Germination, Arid lands, Seeds.
Identifiers: *Salt control, Irrigation agriculture, Recycling.

A method which utilizes solar energy and clear plastic to recycle water from irrigated furrows to adjacent seed or plant beds was proposed for soil moisture and salt control in irrigation. Clear plastic canopies over the irrigated furrows prevented evaporation and maintained a moist seed bed for long periods of time. Harmful concentrations of soluble salts can also be redistributed within the bed by recycling water from the wetted furrow. Installation of the hydrologic minicycle system can be useful in areas of insufficient rainfall and high temperatures, especially where water is costly or of poor quality. Warmer soil temperatures found in the plant beds beneath the edge of plastic canopies could facilitate early spring seed germination when solar energy is available but outside air temperatures are still too low for a normal seeding date. (Affleck-Arizona)
W69-05076

OPERATING POLICIES FOR IRRIGATION SYSTEMS UNDER STOCHASTIC REGIMES,
Harvard Univ., Cambridge, Mass.
For primary bibliographic entry see Field 06A.
W69-05131

OPERATING POLICIES FOR IRRIGATION SYSTEMS UNDER STOCHASTIC REGIMES: DYNAMIC PROGRAMMING MODEL,
Harvard Univ., Cambridge, Mass.
For primary bibliographic entry see Field 06A.
W69-05132

OPERATING POLICIES FOR IRRIGATION SYSTEMS UNDER STOCHASTIC REGIMES: SEQUENTIAL LINEAR PROGRAMMING MODEL,
Harvard Univ., Cambridge, Mass.
For primary bibliographic entry see Field 06A.
W69-05133

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

CONTROL OF SUBMERSED AQUATIC WEEDS IN IRRIGATION CANALS BY DAILY APPLICATIONS OF LOW CONCENTRATIONS OF COPPER SULFATE,
Bureau of Reclamation, Denver, Colo.
Thomas R. Bartley.
Pap, Amer Soc Civ Eng Nat Meet Water Resour Eng, New Orleans, La, Feb 1969. 16 p, 3 tab, 5 ref, append.

Descriptors: *Copper sulfate, Sago pondweed, Water quality, Algicides, *Pondweeds, Algae, *Aquatic weed control, Operation and maintenance, Water temperature, Toxicity, Dosage, Aquatic weeds, *Herbicides, Canals, Irrigation canals, Weed control, Phytotoxicity, Irrigation operation and maintenance.
Identifiers: *Submersed weeds, *Filamentous algae.

A field experiment was started in 1966 to determine the effectiveness of daily applications of copper sulfate in low concentrations in controlling submersed aquatic weeds, and to study related factors in developing this technique for aquatic weed control. Factors other than herbicidal effectiveness considered include: (1) performance and maintenance of a copper sulfate feeding device, (2) appropriate size of copper sulfate crystals for the feeder, (3) schedule of copper sulfate feeding rates, (4) effects of copper sulfate on nontarget organisms, and (5) water quality and temperature. Results of the 3-yr field study show effective control of sago, leafy and horned pondweed, elodea, and filamentous green algae. Recommendations are given on materials and techniques for using copper sulfate control in canals. Copper sulfate appears to be the safest aquatic weed herbicide available in regard to toxicity to nontarget organisms. (USBR)
W69-04729

THE GENERAL POLICY OF THE IRANIAN MINISTRY OF WATER AND POWER IN DEVELOPMENT OF WATER RESOURCES,
Ministry of Water and Power, Tehran (Iran).
A. G. Bayani.
For the 8 Volume Proceedings, see Vol 2, No 9, Field 06B, W69-03305. Int Conf on Water for Peace, Wash, D C, Vol 6, pp 59-67 1968. 9 p.

Descriptors: *Water resources development, *Optimum development plans, *Water conservation, *Water allocation (Policy), Water policy, Water utilization, Inter-basin transfers, Multiple-purpose projects, Evaporation, Seepage, Water loss, Governments, Project planning, Regulation, Water demand.
Identifiers: *Iran, National water policy.

The general policy of the Iranian Ministry of Wate and Power is summarized. Surface waters are retained in surface and underground reservoirs. The possibility of artificial recharge by inspreading basins and by building of small dams and the drilling of recharge wells is being studied. The existing irrigation networks are being modified to reduce water losses. River flow is transferred from northern and southern slopes of Iran's plateau to the central part. Some structures of this type have already been constructed, for example, the Koohrang Tunnel which brings water to the central plateau from some of the tributaries of the Karoon River, flowing to the Persian Gulf. Because of the extensive area covered by evaporitic formations many of the rivers which are fresh at their origin become saline due to dissolution of soluble salts. Investigations in the Rezaien Lake Catchment Basin are concerned with this type of salinity problem. These investigations are being expanded to various regions of the country. Since 1962 semi-detailed groundwater surveys have been carried out in 14 regions. Detailed studies covering the entire country will take many years so a reconnaissance program has been established. Many springs emerge from limestone formations in the Zagros range. These indicate that in certain areas, limestone formations are capable of producing large quantities of water; it is necessary to investigate them as sources of underground water. The central and southern regions of Iran are covered by great salt marshes-the water table in these regions ranges from 0 to 7 ft and, naturally contains great amounts of salt (averaging from 4000 to 17,000 mg/l). The quality and quantity of waters existing below the surface of the Kavir are largely unknown, but no doubt large amounts of water enter these marshy lands. These flows must be controlled and limited. This loss and waste of water by uncontrolled ganats must be prevented. (Knapp-USGS)
W69-04753

FLOOD PLAIN INFORMATION, SANTA FE RIVER, SANTA FE, NEW MEXICO.
Corps of Engineers, Albuquerque, N. Mex.

Prepared for the city of Santa Fe. Corps Eng Flood Plain Rep, May 1968. 31 p, 11 fig, 11 plate, 9 tab.

Descriptors: *Floods, *Flood damage, Flood plains, Flood control, Non-structural alternatives, New Mexico, Maximum probable flood, Historic flood.
Identifiers: Santa Fe (N. Mex), Santa Fe River, Standard project flood, Intermediate regional flood.

Flooding of the Santa Fe River, Santa Fe, New Mexico is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-04783

FLOOD PLAIN INFORMATION, CROW RIVER, ROCKFORD, MINNESOTA.
Corps of Engineers, St. Paul, Minn.

Prepared for village of Rockford. Corps Eng Flood Plain Rep, Feb 1968. 46 p, 10 fig, 8 plate, 7 tab.

Descriptors: *Floods, *Flood damage, Flood plains, Flood control, Non-structural alternatives, Minnesota, Maximum probable flood, Historic flood.
Identifiers: Rockford (Minn), Crow River (Minn), Standard project flood, Intermediate regional flood.

Flooding of the Crow River, Rockford, Minnesota is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-04784

FLOOD PLAIN INFORMATION, LOWER LAS VEGAS WASH, CLARK COUNTY, NEVADA.
Corps of Engineers, Los Angeles, Calif.

Prepared for Clark County. Corps Eng Flood Plain Rep, Dec 1967. 23 p, 4 fig, 18 plate, 5 tab.

Descriptors: *Floods, *Flood damage, Flood plains, Flood control, Non-structural alternatives, Nevada, Maximum probable flood.
Identifiers: Clark County (Nev), Las Vegas Wash, Las Vegas (Nev), Standard project flood, Intermediate regional flood.

Flooding of Lower Las Vegas Wash, Clark County, Nevada is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-04785

FLOOD PLAIN INFORMATION, MISSISSIPPI AND YAZOO RIVERS, VICKSBURG, MISSISSIPPI.
Corps of Engineers, Vicksburg, Miss.

Prepared for the city of Vicksburg and Warren County. Corps Eng Flood Plain Rep, June 1968. 37 p, 9 fig, 22 plate, 7 tab.

Descriptors: *Floods, *Mississippi River, *Flood damage, Flood plains, Flood control, Non-structural alternatives, Mississippi, Maximum probable flood, Historic flood.
Identifiers: Vicksburg (Miss), Yazoo River (Miss), Standard project flood, Intermediate regional flood.

Flooding of the Mississippi and Yazoo Rivers, Vicksburg, Mississippi is described in a report of flood plain problems based on records on rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-04786

FLOOD PLAIN INFORMATION, SOUTH FORK OF THE CROW RIVER, DELANO, MINNESOTA.
Corps of Engineers, St. Paul, Minn.

Prepared for the village of Delano. Corps Eng Flood Plain Rep, June 1968. 54 p, 21 fig, 6 plate, 7 tab.

Descriptors: *Floods, *Flood damage, Flood plains, Flood control, Non-structural alternatives, Minnesota, Maximum probable flood, Historic flood.
Identifiers: Delano (Minn), Crow River (Minn), Standard project flood, Intermediate regional flood.

Flooding of the South Fork of the Crow River, Delano, Minnesota is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-04787

CAN WE CONTROL THE ARCTIC CLIMATE,
P. M. Borisov.
Bull At Sci, Vol 25, No 3, pp 43-48, Mar 1969. 6 p, 1 fig, 1 tab.

Descriptors: *Climatology, *Climatic zones, *Arctic Ocean, *Arid lands, Arid climates, Atlantic Ocean, Water level, Sea level, Sea water, Basins, Water balance, Temperature, Temperature control, Population, Dams, Dam sites, Dam construction, Glaciation, Glaciers, Snowmelt, Ice breakup, Ice loads, Pacific Ocean.
Identifiers: Bering Strait Dam.

An examination is made by a Soviet climatologist of a means of warming the climate of Siberia and other northern regions for development by an expanding population. The construction of a dam across the Bering Strait is proposed, which would control the flow of warmer Atlantic water into the Arctic basin and drive the colder Arctic water into the Pacific Ocean through the Strait. Calculations made by the author indicate that 10-14 deg C increase in the surface water temperature as a result of water transfer, in the Arctic Basin and on the shores of Siberia and Alaska will not create any imbalance of the Antarctic ice-sheet, and the melting of the Greenland ice cap might cause the sea level to rise at a rate of 1.5 to 2.0 mm/year. Construction of the dam across the Bering Strait is considered technically feasible. (Gabriel-USGS)
W69-04790

THE DYNAMIC CHARACTER OF MULTIPURPOSE RIVER DEVELOPMENT: THE TVA EXPERIENCE,
Aubrey J. Wagner.
For 8 volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 8, pp 611-618, 1968. Washington: U S Gov't Printing Office, 8 p, 1 map.

Descriptors: *Tennessee Valley Authority Project, Federal project policy, Water management (Applied), Multipurpose projects, Recreation, *Water resource development, Watershed management, *Resource development, Flood control, Transportation, Electric power, Nuclear energy, Water quality, Environmental effects.
Identifiers: Underdeveloped countries.

This paper discusses water resource development in the Tennessee Valley since the creation of TVA. Since the Tennessee Valley was an underdeveloped area in the early period of TVA, the paper emphasizes those features of the TVA experience which will be of assistance to the developing nations of the world. The water resource in its developed state becomes a basic tool of area development. The paper describes how multipurpose river development helps to break bottlenecks to economic progress. The paper shows that dam and reservoir construction creates new situations, physical and economic, which require attention. The paper points out that as economic and social growth take place within the watershed, accommodations are required both in regulating structures and in their operation. The paper stresses the desirability of unified management of the river control system and the shorelines of the reservoirs in order to achieve the highest public benefit. (Winn-Rutgers)
W69-04818

BARBER PURE MILK CO V YOUNG (OBSTRUCTION OF SURFACE WATER FLOW).
For primary bibliographic entry see Field 06E.
W69-04863

MCHENRY V FORD MOTOR CO (EROSION BY WATERS OF RESERVOIR).
For primary bibliographic entry see Field 06E.
W69-04864

STATE V ANDERSON (ACTION TO ESTABLISH FLOWAGE EASEMENT).
For primary bibliographic entry see Field 06E.
W69-04865

LIPPMAN V HUHN (RIGHT TO ESTABLISH PUBLIC DRAINAGE DITCHES).
For primary bibliographic entry see Field 06E.
W69-04866

RUBIN V STATE (DRAINAGE WATER DIVERSION).
For primary bibliographic entry see Field 06E.
W69-04868

LIBBY, MCNEIL AND LIBBY V ROBERTS (INTERFERENCE WITH NATURAL DRAINAGE COURSE).
For primary bibliographic entry see Field 06E.
W69-04872

LIABILITY, AS REGARDS SURFACE WATERS, FOR RAISING SURFACE LEVEL OF LAND,
For primary bibliographic entry see Field 06E.
W69-04873

FISCHER V TOWN OF ALBIN (TOWN MAY NOT ALTER DRAINAGE DISTRICT WITHOUT CONSIDERING RIGHTS OF DISTRICT LANDOWNERS).
For primary bibliographic entry see Field 06E.
W69-04874

LYTLE V PENNSYLVANIA RR (BRIDGE CONSTRUCTION AND OBSTRUCTION TO FLOW).
For primary bibliographic entry see Field 06E.
W69-04880

COUNTY CONTROL OF DAM CONSTRUCTION.
For primary bibliographic entry see Field 06E.
W69-04881

SEWERS AND DRAINS.
For primary bibliographic entry see Field 06E.
W69-04885

SAWYER V SHADER (OBSTRUCTION TO FLOW).
For primary bibliographic entry see Field 06E.
W69-04888

CRAWFORD V SPRINGVIEW CORP (SURFACE DRAINAGE OVER LOWER ADJACENT TRACT).
For primary bibliographic entry see Field 06E.
W69-04889

BISHOP V RICHARD (OBSTRUCTION OF DRAINAGE BY LOWER LANDOWNER).
For primary bibliographic entry see Field 06E.

W69-04890

GIBSON V SHARP (DRAINAGE DITCH RIGHT OF WAY)
For primary bibliographic entry see Field 06E.
W69-04891

GOTT V FRANKLIN (BARRICADE TO NATURAL SURFACE WATER FLOW).
For primary bibliographic entry see Field 06E.
W69-04892

DAVIS V ATLANTIC COAST LINE RR (DRAINAGE FLOW EASEMENTS).
For primary bibliographic entry see Field 06E.
W69-04893

MASON V LAMB (ACTION TO RECOVER DAMAGES FROM SURFACE WATER RUNOFF ONTO PLAINTIFFS' PROPERTY).
For primary bibliographic entry see Field 06E.
W69-04894

SCHMITT V KIRKPATRICK (DRAINAGE EASEMENT).
For primary bibliographic entry see Field 06E.
W69-04897

BENNETT V COUNTY OF EATON (CONCENTRATED DRAINAGE ONTO LOWER LANDS).
For primary bibliographic entry see Field 06E.
W69-04898

YOUNG V MOORE (LANDOWNERS RIGHT TO DRAIN EXCESS SURFACE WATER).
For primary bibliographic entry see Field 06E.
W69-04899

CLARK V CITY OF SPRINGFIELD (NUISANCE ABATEMENT SEWAGE AND SURFACE WATER).
For primary bibliographic entry see Field 06E.
W69-04900

SCAMP V STATE (ACTION FOR NEGLIGENT HIGHWAY CONSTRUCTION OBSTRUCTING NATURAL SURFACE WATER FLOW).
For primary bibliographic entry see Field 06E.
W69-04901

DE VORE FARMS V BUTLER HUNTING CLUB (DAMS AND OBSTRUCTION TO FLOW).
For primary bibliographic entry see Field 06E.
W69-04916

FLOOD PLAIN INFORMATION, CHARLOTTE AND NORTH LEE COUNTIES, FLORIDA.
Corps of Engineers, Jacksonville, Fla.

Prepared for Boards of County Commissioners of Charlotte and Lee Counties. Corps Eng Flood Plain Rep, May 1968. 42 p, 14 fig, 7 plate, 4 tab.

Descriptors: *Floods, *Flood damage, *Flood plains, Flood control, Non-structural alternatives, Florida, Maximum probable flood, Hurricanes, Coasts, Tides, Historic flood.
Identifiers: Standard project flood, Intermediate regional flood, Charlotte County (Fla), Lee County (Fla).

Flooding in Charlotte and northern Lee Counties, Florida is described in a report of flood problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-04918

FLOOD PLAIN INFORMATION, CAMPBELL CREEK, ANCHORAGE, ALASKA.
Corps of Engineers, Anchorage, Alaska.

Prepared for the Greater Anchorage Borough. Corps Eng Flood Plain Rep, June 1968. 55 p, 13 fig, 12 plate, 16 tab.

Descriptors: *Floods, *Flood damage, Flood plains, Flood control, Non-structural alternatives, Alaska, Maximum probable flood.
Identifiers: Campbell Creek (Alaska), Anchorage (Alaska), Standard project flood, Intermediate regional flood.

Flooding of Campbell Creek, Anchorage, Alaska is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-04919

FLOOD PLAIN INFORMATION, PUPUKEA, OAHU, HAWAII.
Corps of Engineers, Honolulu, Hawaii.

Prepared for State of Hawaii and City and County of Hawaii. Corps Eng Flood Plain Rep, Oct 1968. 24 p, 3 fig, 20 plate, 3 tab.

Descriptors: *Floods, *Flood damage, Flood plains, Flood control, Non-structural alternatives, Hawaii, Maximum probable flood, Historic flood.
Identifiers: Pupukea (Hawaii), Oahu (Hawaii), Standard project flood, Intermediate regional flood.

Flooding of Pupukea, Oahu, Hawaii is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-04920

FLOOD PLAIN INFORMATION, AGUA FRIA RIVER, MARICOPA COUNTY, ARIZONA.
Corps of Engineers, Los Angeles, Calif.

Prepared for County of Maricopa. Corps Eng Flood Plain Rep, Mar 1968. 31 p, 12 fig, 32 plate, 4 tab.

Descriptors: *Floods, *Flood damage, *Flood plains, Flood control, Non-structural alternatives, Arizona, Maximum probable flood, Historic flood.
Identifiers: Maricopa County (Ariz), Agua Fria River (Ariz), Standard project flood, Intermediate regional flood.

Flooding of the Agua Fria River, Maricopa County, Arizona, is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-04921

FLOOD PLAIN INFORMATION, CHESTER CREEK, ANCHORAGE, ALASKA.
Corps of Engineers, Anchorage, Alaska.

Prepared for Greater Anchorage Borough. Corps Eng Flood Plain Rep, June 1968. 56 p, 16 fig, 13 plate, 18 tab.

Descriptors: *Floods, *Flood damage, *Flood plains, Flood control, Non-structural alternatives, Alaska, Maximum probable flood.
Identifiers: Chester Creek (Alaska), Anchorage (Alaska), Standard project flood, Intermediate regional flood.

Flooding of Chester Creek, Anchorage, Alaska is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-04922

FLOOD PLAIN INFORMATION, CHAGRIN RIVER, LAKE AND CUYAHOGA COUNTIES, OHIO.
Corps of Engineers, Buffalo, N. Y.

Prepared for Ohio Dept of Nat Resources, Div of Water. Corps Eng Flood Plain Rep, July 1968. 53 p, 35 fig, 12 plate, 15 tab.

Descriptors: *Floods, *Flood damage, *Flood plains, Flood control, Non-structural alternatives, Ohio, Maximum probable flood, Historic flood.
Identifiers: Cleveland (Ohio), Lake County (Ohio), Cuyahoga County (Ohio), Chagrin River (Ohio), Standard project flood, Intermediate regional flood.

Flooding of the Chagrin River, Lake and Cuyahoga Counties, Ohio is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-04923

FLOOD PLAIN INFORMATION OF PURPLE CREEK IN VICINITY OF JACKSON, MISSISSIPPI.
Corps of Engineers, Mobile, Ala.

Prepared for Jackson City Planning Board. Corps Eng Flood Plain Rep, June 1968. 34 p, 6 fig, 10 plate, 11 tab.

Descriptors: *Floods, *Flood damage, *Flood plains, Flood control, Non-structural alternatives, Mississippi, Maximum probable flood.
Identifiers: Jackson (Miss), Purple Creek (Miss), Standard project flood, Intermediate regional flood.

Flooding of Purple Creek, Jackson, Mississippi is described in a report of flood plain problems based

on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-04924

FLOOD PLAIN INFORMATION, CUYAHOGA RIVER, BIG CREEK AND TINKERS CREEK, CUYAHOGA COUNTY, OHIO.
Corps of Engineers, Buffalo, N. Y.

Prepared for Ohio Dept of Nat Resources, Div of Water. Corps Eng Flood Plain Rep, July 1968. 61 p, 61 fig, 16 plate, 13 tab.

Descriptors: *Floods, *Flood damage, *Flood plains, Flood control, Non-structural alternatives, Ohio, Maximum probable flood, Historic flood.
Identifiers: Cleveland, Cuyahoga River, Big Creek, Tinkers Creek, Cuyahoga County, Standard project flood, Intermediate regional flood.

Flooding of the Cuyahoga River, Big Creek, and Tinkers Creek, Cuyahoga County, Ohio is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W69-04925

FLOOD PLAIN INFORMATION, BLACK HAWK CREEK, BLACK HAWK COUNTY, IOWA.
Corps of Engineers, Rock Island, Ill.

Corps Eng Flood Plain Rep, Dec 1968. 55 p, 36 fig, 17 plate, 11 tab.

Descriptors: *Floods, *Flood damage, *Flood plains, Flood control, Maximum probable flood, Flood forecasting, River forecasting, Flood protection, Hydrograph analysis, Flood plain zoning, Iowa.
Identifiers: Black Hawk Creek (Iowa), Standard project flood, Intermediate regional flood.

Flooding of the Black Hawk Creek, Iowa, is described in a report by the U. S. Corps of Engineers based on the systematic collection of runoff and rainfall data beginning with March 1929. Maps, photographs, profiles, cross sections, and plates indicate the extent of flooding that has occurred and which may be expected to occur in the future. In general, the report should be of value in the study and planning of ways to minimize the intensity of flood damage by control of the flood plain using zoning and subdivision regulations. (Gabriel-USGS)
W69-04926

AQUATIC PLANT NUISANCES,
Interstate Commission on the Potomac River Basin, Washington, D. C.
Charles K. Rawls.
In PROBLEMS OF THE POTOMAC ESTUARY, January, 1964, pp 51-56.

Descriptors: *Maryland, *Virginia, *Aquatic weeds, *Vegetation effects, *Aquatic weed control, Aquatic plants, Appalachian Mountain region, Atlantic coastal plain, Coastal plains, Geographical regions, Northeast U. S., Regions, Southeast U. S., Aquatic life, Plants, Weeds.

The author presents a brief discussion of the two introduced water-plant nuisances in the Potomac Estuary, the water chestnut (Trapa natans L.) and the Eurasian water nilfoil (Myriophyllum spicatum L.). He discusses the problems posed by their occurrence, the extent of infestation, and current control methods and their effectiveness.
W69-05043

REVIEW REPORT ON JAMES RIVER, VIRGINIA.
U. S. Army Engineer District, Norfolk, Corps of Engineers, Norfolk, Virginia, 2 Volumes, January, 1962.

Descriptors: *Rivers, *Channel improvement, *Virginia, *Cost-benefit analysis, Aquatic life, Aquatic animals, Waste disposal, Transportation, Harbors, Benefits, Fish, Wildlife, Animals, Costs, Surveys, Bodies of water, Running waters, Streams, Surface waters, Appalachian Mountain region, Atlantic coastal plain, Coastal plains, Geographical regions, Regions, Southeast U. S.

The purpose of this survey report is to determine the need and justification for the further improvement of James River from its mouth at Hampton Roads to the deep water terminal at Richmond, Virginia, a nautical distance of 86.4 miles. The study has included hydrographic surveys of those sections of the river where natural depths are less than 37 feet; topographic surveys of lands to be cut away in widening the existing channel; outlines of prospective shore areas for disposal of dredged material; planning of channel improvements and estimates of quantities, and costs therefore; and complete economic data to determine savings and benefits to accrue to existing and potential shipping. Two plans for further improvement of the channel are presented. The detailed design and cost estimates for channel improvements and a report on the considered navigation channel improvements in relation to fish and wildlife resources of James River are given in Volume 2.
W69-05045

A GUIDE TO THE CONSERVATION OF SHORELINES, SUBMERGED BOTTOMS AND SALTWATERS WITH SPECIAL REFERENCE TO BULKHEAD LINES, DREDGING AND FILLING,
Florida State Board of Conservation, St. Petersburg. Marine Lab.
Kenneth D. Woodburn.
Educational Bulletin No. 14, September, 1963.

Descriptors: *Conservation, *Shores, *Beds, *Saline water, Landfills, Land development, Dredging, Bulkhead line, Water types, Standards, On-site investigations, Maps, Publications, Florida, Atlantic coastal plain, Coastal plains, Geographical regions, Gulf coast plain, Regions, Southeast U. S.

A guide is presented for evaluating marine productivity and adopting standards for waterfront development. Some of the factors considered include: the use of field inspection, interviews and consultation, and publications and maps. Guidelines that were developed for Manatee County by the Florida Board of Conservation for establishment of bulkhead lines are listed. The approach suggested appears to be based primarily upon the making of qualitative judgments rather than evaluation of economic 'trade-offs'.
W69-05068

INTERRELATIONSHIP BETWEEN PHYSIOGRAPHY, HYDROLOGY, SEDIMENTATION, AND SALINIZATION OF THE LODDEN RIVER PLAINS, AUSTRALIA,
Geological Survey of Australia, Melbourne.
For primary bibliographic entry see Field 02A.
W69-05079

EFFECTS OF SEEDBED TREATMENT ON GRASS ESTABLISHMENT ON LOGGING ROADBEDS IN CENTRAL IDAHO,
Forest Service (USDA), Boise, Idaho. Intermountain Forest and Range Experiment Station.
Walter J. Kidd, Jr., and Harold F. Haupt.
U.S.D.A. Forest Serv. Res. Pap. INT-53, 1968, 9 pp, illus.

Descriptors: *Erosion control, *Soil stabilization, *Vegetation establishment, *Roads, *Planting management, Fertilization, Seeds, Grasses, Mulching, Watershed management, Conservation.
Identifiers: *Scarification, Slope aspect, Logging (Forest).

Deep and shallow scarification treatments, before and after broadcasting seed, were studied to determine if they would be conducive to establishment of a heavier stand of grass than could be obtained by merely broadcasting seed. Mulching with wood chips and fertilizing were also tried. Results show a slight advantage for deep scarification before seeding. Three of five perennial species became well established; the other two did poorly. Crested and intermediate wheatgrass and smooth brome produced good cover; timothy and bulbous bluegrass produced sparse cover. Establishment of seedlings was significantly affected by site aspect and mulch.
W69-05096

CONTROLLING SOIL MOVEMENT FROM STEEP ROAD FILLS,
Forest Service (USDA), Boise, Idaho. Intermountain Forest and Range Experiment Station.
Nedavia Bethlahmy, and Walter J. Kidd, Jr.
U.S.D.A. Forest Service Res. Note INT-45, 1966, 4 pp.

Descriptors: *Roads, *Bank protection, *Vegetation establishment, *Erosion control, *Planting management, *Soil stabilization, Seeds, Fertilizers, Mulching, Grasses, Sediments, Erosion.
Identifiers: *Netting (Soil cover).

Eight test plots were established on the fill slope of a newly constructed road. One plot was retained as a control, while different soil-stabilizing treatments were used on each of the other plots. These consisted of various combinations of seeding, fertilizing, mulching, and surface netting. Treatments that included both straw mulch and netting effectively controlled erosion.
W69-05105

PROBABLE MAXIMUM PRECIPITATION OVER SOUTH PLATTE RIVER, COLORADO AND MINNESOTA RIVER, MINNESOTA,
Weather Bureau, Silver Spring, Md.
John T. Reidel, Francis K. Schwarz, and Robert L. Weaver.
Hydrometeorological Report No. 44, January 1969. 114 p, 10 tab, 18 fig, 7 ref.

Descriptors: *Probable maximum precipitation, *Design criteria, *Weather patterns, Snowmelt, Water control.
Identifiers: South Platte River (Colorado), Minnesota River (Minnesota).

In this report meteorological criteria are given for planning and design of spillways and other water control structures within two drainages: (a) South Platte River above Chatfield Dam site, Colorado; (b) Minnesota River, Minnesota. The report is one of 44 similar major reports that have been mostly prepared for and financed by the Corps of Engineers. Estimates of probably maximum precipitation (PMP) are given for each river basin and selected subbasins. Durations of rainfall are up to 3 days. Seasonal variation of PMP is given in order that the combined snowmelt and rain flood can be evaluated. Critical sequences of snowmelt winds and temperatures are given for the springtime PMP storm and for several prior days. Areal distribution of rainfall during the PMP storm is given by

average depths over subbasins in the case of the South Platte River Basin and by isohyetal maps for each subbasin of interest in the Minnesota River Basin. (Strahl-ESSA)
W69-05158

REDDMANN V REDDMANN (OBSTRUCTION TO SURFACE WATER FLOW).
For primary bibliographic entry see Field 06E.
W69-05174

ROBINSON V BELANGER (SURFACE WATER DRAINAGE RIGHTS).

332 Mich 657, 52 NW 2d 538-542 (1952).

Descriptors: *Michigan, *Runoff, *Earth dams, *Obstruction to flow, Riparian rights, Riparian lands, Lakes, Surface runoff, Precipitation excess, Surface drainage, Rainwater, Storm runoff, Drainage water, Easements, Boundaries (Property), Judicial decisions, Legal aspects, Ownership of beds, Abatement, Relative rights, Remedies.

Plaintiff brought action to enjoin construction of an embankment which prevented the waters of a lake from flowing upon the premises of the plaintiff and, at the same time, prevented surface water drainage from the plaintiff's premises into the lake. The lower court ordered removal of the entire embankment, noting that it impounded the lake waters and would tend to cause stagnation. The reviewing court found that the plaintiff had no riparian rights, and thus had no standing to seek relief on the grounds used by the lower court. However, plaintiff could assert interference with a servitude, existing in favor of the upper estate, permitting the natural flowage of surface water over and upon the lower tract. The court remanded the case for a determination of the size of the opening which would be required to permit surface waters to flow into the lake. (Katz-Fla)
W69-05177

WATTERS V NATIONAL DRIVE-IN (SURFACE WATER DRAINAGE DAMAGE).
For primary bibliographic entry see Field 06E.
W69-05178

CAPES V BARGER (DAMAGES CAUSED BY DAM TO REPEL SURFACE WATERS).
For primary bibliographic entry see Field 06E.
W69-05181

H B CARTER V CHUQUATONCHEE CONSOLIDATED DRAINAGE DISTRICT (DRAINAGE DISTRICT DISSOLUTION).
218 So 2d 30-33 (Miss 1969).

Descriptors: *Mississippi, *Judicial decisions, *Drainage districts, *Consolidation, Governments, Legal aspects, Local governments, Leglislation, Canals, State governments, Drainage systems.
Identifiers: District consolidation.

Petitioners, property owners, sought to dissolve a consolidated drainage district which maintained and operated a drainage canal constructed by its three constituent drainage districts. Section 4733 Mississippi Code 1942 Annotated (1956) provides that any drainage district having no unmatured bonded indebtedness or assets may be dissolved after 3 years from the date of its creation. A prior constructed drainage canal in each constituent district is necessary for consolidation. The court denied petitioner's action for dissolution. The fact that the original drainage districts made improvements prior to their consolidation prevents the dissolution. Upon consolidation these improvements become an asset of the consolidated district. (Molica-Fla)
W69-05183

RIDDLE V BALTIMORE AND OHIO (FLOOD DAMAGE CAUSED BY INADEQUATE CULVERT).

73 SE 2d 793-809 (W Va 1952).

Descriptors: *Obstruction to flow, *West Virginia, *Flood damage, *Precipitation excess, Rainfall intensity, Judicial decisions, Damages, Rainfall, Railroads, Culverts, Rainfall disposition, Excessive precipitation, Rain gages, Runoff, Drainage, Impact (Rainfall), Surface runoff, Floods, Cloudbursts, Hydrographs, Storms, Climatology, Thunderstorms, Storm runoff, Remedies, Legal aspects.
Identifiers: *Act of God, Proximate cause.

Plaintiff brought suit for damages against defendant railroad for flooding of plaintiff's residential property allegedly due to the inadequacy of a culvert constructed by defendant through the fill in a roadbed. The culvert was insufficient to handle the drainage during an excessive rainfall. Defendant contended that the rainstorm constituted an independent intervening cause, breaking the chain of proximate causation between the negligent act and the damage incurred. The court affirmed the lower court's holding that such rainfall should have been anticipated from the climatological history of the area. One who obstructs a natural watercourse will not be excused from liability for damages resulting therefrom on the theory of act of God, unless the act of God was the sole and proximate cause of the injury. That which reasonable human foresight, pains, and care should have prevented cannot be called an act of God. (Heckerling-Fla)
W69-05191

NASS V TOWN OF DUXBURY (DIVERSION OF FLOW BY CHANNEL OBSTRUCTION).

99 NE 2d 54-57 (Mass 1951).

Descriptors: *Massachusetts, *Riparian rights, *Alteration of flow, *Remedies, Channel flow, Judicial decisions, Beaches, Sands, Erosion, Water pollution, Land tenure, Deflection damages, Legal aspects.
Identifiers: *Burden of proof, *Expert testimony.

Plaintiff and defendant occupied opposite sides of a river which formed the boundary between their respective lots. The defendant created a sandy beach by dumping white sand into the watercourse. The sand blocked off one channel, causing a deflection of the flow into the other channel. Plaintiff claimed such deflection caused a scouring out and removal of a portion of his land. On appeal from a denial of defendant's motion for a directed verdict, the Supreme Judicial Court held that, in order to recover damages, the evidence had to establish a greater likelihood that injury was caused by the alleged nuisance than by some other force. A definite causal connection had not been established, and the lower court erred in refusing to direct a verdict for defendant absent such proof. (Harris-Fla)
W69-05197

DRUMMOND V FRANK (OBSTRUCTION OF SURFACE FLOW).

41 So 2d 268-273 (Ala 1949).

Descriptors: *Alabama, *Surface runoff, *Obstruction to flow, *Prescriptive rights, Surface waters, Water law, Relative rights, Judicial decisions, Surface drainage, Backwater, Storm drains, Ditches, Natural flow, Rain water, Storm runoff, Legal aspects.
Identifiers: Injunctions (Prohibitory), Standing, Injunctions (Mandatory).

Respondent owned property at the higher end of an alley which property was bordered by land owned by complainants. Only defendant and one complaint had a property interest in the alley. Complainants sued to enjoin respondent from further filling in the alley and to compel removal of materials already placed upon the alley; damages resulting from the obstruction of the natural flow of surface water from complainants' lands were also sought. The court below granted the relief prayed for and awarded damages to all complaints. The appellate court reversed in part, holding that only the party with a property interest in the alley had a right of action for injunctive relief and damages; evidence was insufficient to establish a prescriptive right in the order complainants. The decree was affirmed in so far as it adjudicated rights of those parties possessing proprietary interests in the alley, and the case was remanded for proper assessment of damages. (Wheeler-Fla)
W69-05200

4B. Groundwater Management

CONCEPTS IN GROUND WATER MANAGEMENT,
John F. Mann, Jr.
J Amer Water Works Ass, Vol 60, No 12, pp 1336-1344, Dec 1968. 9 p, 22 ref.

Descriptors: *Groundwater, Groundwater mining, Water quality, Thermal pollution, Aquifers, Groundwater flow, Groundwater movement, Groundwater basins, Groundwater recharge, Salinity, Water reuse, Filtration, Quality control, Waste water treatment, Turbidity, Temperature control, Waste water disposal, Water table, Bibliographies, Safe yield.
Identifiers: *Groundwater management, Artificial replenishment, Groundwater hydrology.

The goals of ground-water management are part of a general objective of serving present and future demands for water at minimum cost and acceptable quality. The goals should be coldly practical, recognizing that almost every use of water results in some biological, chemical, or thermal deterioration. In most basins the goal is continued usability. The trend is toward better control of the amounts and patterns of extractions, augmenting recharge to ground storage, decreasing evapotranspirative waste or outflows that go to waste, controlling mineral and thermal pollution, intensifying use of ground-water storage, and avoiding damage caused by high water tables or land-surface subsidence. Management objectives are aided by powerful computer techniques (developed mainly within the last 10 yr) that predict and test the effects of many assumptions on the ground-water body. (USBR)
W69-04704

OPERATION OF A RECHARGE BOREHOLE,
Willcox, Raikes and Marshall, Consulting Engineers (Gt. Brit.).
J. K. Marshall, A. Saravanapavan, and Z. Spiegel.
Inst Civ Eng Proc, Vol 41, pp 447-473, Nov 1968. 27 p, 9 fig, 8 ref, 5 append.

Descriptors: Boreholes, Conductivity, Recharge, *Recharge wells, Theis equation, Aquifers, Groundwater, *Groundwater recharge, Iron bacteria, Groundwater mining, Irrigation water, Water supply, *Water wells, Wells, Irrigation wells, Suspended solids, Suspended sediments, Well filters, Groundwater geology, Salt velocity method.
Identifiers: Foreign testing, Great Britain, Well failures, Pumping tests.

A deep borehole was used as a source of irrigation water for the Birmingham Racecourse, Warwickshire, Great Britain, in the summer and recharged during the winter. Recharging the relatively small amount of water abstracted for irrigation, about 3.6 million gal/yr, was difficult. Experiments were made to find the cause of the recharge failure. Measures to improve recharge performance were found, but before these could be fully implemented, the racecourse was sold for a housing development and the borehole became redundant. Borehole operations over a 2-1/2-yr period are discussed and experiments described. Factors investigated include: (1) suspended matter

in the borehole, (2) characteristics of recharge water, and (3) presence of iron bacteria in the borehole. Experiments included salt injection and measurement of flow with a suspended conductivity cell. Pumping records were analyzed, using Theis and Hantush equations, to interpret aquifer behavior. The main conclusion is that the initial recharge failure was caused primarily by solids deposited on the face of the borehole or in pores immediately around the borehole. (USBR)
W69-04723

WASTE WATER CONSERVATION AND RENOVATION RESEARCH,
Pennsylvania State Univ., University Park.
For primary bibliographic entry see Field 05D.
W69-04748

THE GENERAL POLICY OF THE IRANIAN MINISTRY OF WATER AND POWER IN DEVELOPMENT OF WATER RESOURCES,
Ministry of Water and Power, Tehran (Iran).
For primary bibliographic entry see Field 04A.
W69-04753

KOCH V WICK (PRIVATE OWNER MAY ENJOIN COUNTY'S ATTEMPT TO USE GROUNDWATER ON OTHER THAN OVERLYING LAND).
For primary bibliographic entry see Field 06E.
W69-04870

LABRUZZO V ATLANTIC DREDGING AND CONST CO (ACTION TO RECOVER DAMAGES FOR DISRUPTION OF UNDERGROUND STREAM).
For primary bibliographic entry see Field 06E.
W69-04909

LABRUZZO V ATLANTIC DREDGING CONSTRUCTION CO (EXCAVATION DIVERTING UNDERGROUND WATERS).
For primary bibliographic entry see Field 06E.
W69-04910

4C. Effects on Water of Man's Non-Water Activities

CONTRIBUTION CONCERNING THE FLOW RATES OF RIVERS TRANSPORTING DRAIN WATERS OF OPEN-CAST MINES,
Wasserwirtschaftsdirektion, Cottbus (East Germany).
Walter Golf.
Int Ass Sci Hydrol Pub No 76, Symp on Hydrol Aspects of Util of Water, Bern, Sept 25-Oct 7, 1967, pp 306-316, 1968. 11 p, 6 fig, 3 tab.

Descriptors: *Streamflow, *Flow characteristics, *Strip mines, *Mine drainage, Groundwater movement, Surface-groundwater relationships, Base flow, Hydrographs, Hydrograph analysis, Dewatering, Stream gages, Discharge (Water).
Identifiers: Germany, DDR, Spree River (DDR).

The draining of the coal srip-mines of lower Lusatia, Germany, and the effect on the hydrology of the Spree River and its tributaries is discussed. The quantitative effects on the surface-discharge caused by lowering the groundwater table and draining the waters of the open-cast mines may be divided into a long-term increase or decrease of the total discharge rate which is related to depletion or refilling the groundwater reservoir and into the equalization of flow-rates which is related to an increase of retention and an improvement of the absorbing conditions in the mining area. The influences may be quantified by a comparison of analogous drainage areas with and without mining or by an analysis of long-term observations of discharge rates relating to the period before mining began. The results are only of local validity. However, based on these studies, it is possible to establish general principles for calculating the flow rates of rivers transporting open-cast mine drain waters. (Knapp-USGS)
W69-04956

SEDIMENT,
Interstate Commission on the Potomac River Basin, Washington, D. C.
For primary bibliographic entry see Field 04D.
W69-05029

4D. Watershed Protection

PREDICTION OF WATERSHED DEVELOPMENT SUCCESS OF LOCAL COMMUNITIES,
P. Thomas Cox.
For 8 Volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 8, pp 772-779, 1968. Washington, D C: U S Government Printing Office, 8 p, 3 tab, 5 ref.

Descriptors: Environment, Watershed management, Forecasting.
Identifiers: *Watershed development, Discriminant analysis, Socio-economic variables, Local communities, Chance of success.

This paper reports the results of an intensive analysis of the performance of more than 180 upstream watershed development projects which were started by local citizens. Through the use of discriminant analysis, the watersheds were classified into four groups representing slow to fast rates of development. These groups were then separately analyzed to discover the basis for the observed difference. There was found to be a wide divergence in the ability of communities to inaugurate and carry to completion water development projects. Since planning funds are always scarce, the available funds should be allocated to those communities showing the ability to carry out water development projects. The ability to select the more adept areas could save a governmental water planning agency significant funds. Through the utilization of classification function coefficients developed by the discriminant program, 66 future communities needing water development projects were classified into groups predicted to achieve development with fast to slow rates. (Loeb-Rutgers)
W69-04822

SEDIMENTATION FROM A HYDRAULIC DREDGE IN A BAY,
Thomas R. Hellier, Jr., and Louis S. Kornicker.
Institute of Marine Science, Vol 7, 1962, pp 212-215.

Descriptors: *Dredging, *Silts, *Spoil banks, *Sediment transport, *Gulf coastal plains, Channel improvement, Fine textured soils, Pervious soils, Soil types, Texas, Central U. S., Coastal plains, Geographical regions, Regions, Southwest U. S., Inland waterways, Channels.

Red gravel was used to mark the movement of sediment after the dredging of a section of an intercoastal waterway near Arkansas Pass, Texas. The spoil was placed in 'spoil banks'. Eighteen months later a negligible amount of silt had by-passed the spoil island or was eroded from the island.
W69-05000

SEDIMENT,
Interstate Commission on the Potomac River Basin, Washington, D. C.
Paul W. McKee.
In Problems of the Potomac Estuary, January, 1964, pp 40-46.

Descriptors: *Soil erosion, *Surface runoff, *Construction, *Urbanization, *Maryland, Erosion, Sediment discharge, Sediment control, Runoff, Surface drainage, Drainage, Appalachian Mountain region, Atlantic coastal plain, Coastal plains, Geographical regions, Northeast U. S., Regions.

The control of erosion resulting from urban development has been largely ignored. This report presents some data to show the sediment yields of various areas in Maryland. Sediment yields from construction sites are from three to 100 times the average yield from rural areas.
W69-05029

EFFECTS OF SEEDBED TREATMENT ON GRASS ESTABLISHMENT ON LOGGING ROADBEDS IN CENTRAL IDAHO,
Forest Service (USDA), Boise, Idaho. Intermountain Forest and Range Experiment Station.
For primary bibliographic entry see Field 04A.
W69-05096

EFFECT OF EXPOSURE AND LOGGING ON RUNOFF AND EROSION,
Forest Service (USDA), Boise, Idaho. Intermountain Forest and Range Experiment Station.
Nedavia Bethlahmy.
U.S.D.A. Forest Serv. Res. Note INT-61, 1967, 7 pp.

Descriptors: *Overland flow, *Erosion control, *Infiltration, *Infiltrometers, Rainfall intensity, Watershed managment, Accelerated erosion, Simulated rainfall, Sediments, Forest soils, Forest management.
Identifiers: *Logging (Forest), *Slope aspect.

High-intensity rainfall was applied artificially to plots on eight steep, forested areas in the Payette National Forest in central Idaho. Logged and unlogged sites on northeast and southwest exposures were represented equally. Results show that runoff and erosion are greater on southwest than on northeast exposures, and that even after careful logging, erosion increases on southwest but not significantly on northeast exposures.
W69-05104

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

SCIENTIFIC PARAMETERS OF MARINE WASTE DISCHARGE,
Harvey F. Ludwig, and Ben Onedera.
International Journal of Air and Water Pollution, Vol 7, No 2/3, May, 1963, pp 159-172.

Descriptors: *Water pollution, *Ecology, *Data collections, *Treatment facilities, Monitoring, Aquatic productivity, Plant growth, Nutrients, Productivity, Water treatment.

The article presents a discussion of a study undertaken by Engineering-Science, Inc., on behalf of the California State Water Pollution Control Board, for the 'assembly, collation, and critical review of the sizeable mass of marine monitoring data accumulated over the past decade, both for 'open' coastal waters and for 'restricted' waters such as estuaries and bays'. It presents conclusions on the meaningfulness and usefulness of specific types of measurements employed, the effects of monitoring program findings on design of treatment facilities, and the significance of information voids.
W69-05018

THE DIFFERENTIATION, ANALYSIS, AND PRESERVATION OF NITROGEN AND PHOSPHORUS FORMS IN NATURAL WATERS,
California Univ., Berkeley. Sanitary Engineering Research Lab.
David Jenkins.

Trace Inorganics in Water, Advances in Chemistry Series, Number 73, pp 265-280, Amer Chem Soc, Washington, DC, 1968. 2 fig, 6 tab, 20 ref.

Descriptors: *Water chemistry, *Nitrogen compounds, *Phosphorus compounds, Chemical analysis, Water analysis, Water chemistry, Eutrophication, Nitrogen, Ammonia, Nitrites, Nitrates, Organic phosphorus, Phosphates, Estuaries, Estuarine environment, Saline water, Water quality.
Identifiers: San Francisco Bay.

For waters of varying salinity, such as San Francisco Bay, techniques were developed for differential analyses of suspended and soluble organic nitrogen, ammonium-nitrogen, nitrite-nitrogen, nitrate-nitrogen; total and soluble phosphorus; soluble orthophosphate; and condensed phosphate. Certain modifications of standard methods were required. Samples preserved by storage (1) at 4 deg C, (2) at -10 deg C, (3) at 4 deg C with added 2 ml/liter of 5% sulfuric acid, and (4) at 4 deg C with mercuric chloride at 40 mg mercuric ions per liter were compared for periods of a few days to one month. For all forms of nitrogen, storage at 4 deg C with 40 mg mercury per liter was best but did not hold initial levels of organic nitrogen or nitrite-nitrogen as long as 30 days. Most satisfactory for phosphorus was storage at -10 deg C with mercury for 30 days or 4 deg C with mercury for a few days. Chloroform preservation for phosphorus caused marked reduction in soluble orthophosphate and accompanying increase in total soluble phosphorus. (McCoy-Wisconsin)
W69-05137

5B. Sources of Pollution

EFFECTS OF MULTIPLE USES OF WATERSHEDS ON WATER QUALITY,
Federal Water Pollution Control Administration, Washington, D. C.
John M. Rademacher.
J Amer Water Works Ass, Vol 60, No 11, pp 1247-1254, Nov 1968. 8 p.

Descriptors: *Multiple use, Effects, *Watersheds (Basins), Recreation, *Water quality, *Drainage basins, *Watershed management, Potable water, Operation and maintenance, Pollution abatement, Spilling, Contamination, *Water pollution, Sewage, Waste disposal, Waste treatment, Standards, Boats.
Identifiers: Federal Water Pollution Control Act, Pollution control, Federal-State cooperation, Contaminants.

Any definitive study of the effects of multiple uses of watersheds on water quality would consider all of the generally recognized uses--water supply, agriculture, navigation, and recreation. Controlling wastes from these activities is an over-present problem. The primary concern is the efficient design, operation, and maintenance of waste treatment plants. Federal and state control pressures for design and operation, development of training opportunities for waste treatment plant operations, technical experts for solving the many anomalies, and monetary incentives are key elements needed to close designing and operating gaps. Spill pollution is an ever-present threat to watersheds from a variety of potential sources. Legislative relief measures to accelerate developing a workable prevention program, further refinement of surveillance and notification for spill situations, and blending of a Federal-state government reaction capability, drawing heavily on industry, are program approaches applicable to all areas. Waste control from watercraft requires developing uniform regulations, effective onboard treatment or control systems, and shore-based support facilities. Solving pollution problems will be an important step toward the clean water goal. (USBR)
W69-04702

DETERMINATION, EVALUATION AND ABATEMENT OF COLOR IN TEXTILE PLANT EFFLUENTS,
Georgia Inst. of Tech., Atlanta. French Textile School.
R. K. Flege.
Supported in part by Textile Educ Found, Inc, and Ga Textile Mfg Ass, Inc. Water Resources Res Center Completion Rep WRC-0868, Georgia Inst Technol, Dec 1968. 59 p, 3 fig, 4 tab, 18 ref, 3 append. OWRR Project B-012-GA.

Descriptors: *Water pollution, *Dye releases, *Pollutants, *Textiles, Georgia, Color, Surfactants, Degradation (Stream), Biodegradation, Waste water disposal.
Identifiers: Coosa River, Conasauga River, Oostantaula River.

Data on quantities of dyestuffs and chemicals used by representative dyers and finishers of textile products in the Coosa River basin in Georgia were analyzed by graduate students. Processing chemicals yield an effluent of about 2,000 ppm, but maximum dyestuff content is only about 7 ppm in the effluent. Dyehouse effluent was colored only where the effluent was discharged periodically into a stream, or receiving lagoon, or a treatment plant; but color was reduced significantly by conventional waste treatment or aeration in sunlight. Many dyes are not responsive to treatment and conventional spectrophotometric methods were unsatisfactory for color evaluation of streams. Under severe drought conditions total flow in the Conasauga River may be composed entirely of textile mill effluent plus outfall from a modern waste treatment facility. Growth of the textile industry in the Coosa, Conasauga and Oostanaula River valleys may aggravate further the pollution problem. Treatment of textile wastes with surfactants may be an economically feasible means for abatement of pollution in streams where surfactants of the LAS type were a primary cause of foam and turbidity. The molecular structure of dyestuff significantly affects the rate of biological degradation with the azo linkage in some disperse dyes being degradable in conventional waste treatment systems. Anaerobic conditions were required for the reduction of the more hydrophobic dyes. Chemical methods for degrading dyes and chemicals in dyehouse effluents are suggested. Partial biological degradation of dye yielded colorless toxic aromatic amine metabolite with degradation of sludge. Tables show some possible degradation products from dyestuffs. (Vorhis-USGS)
W69-04756

UNUSUAL PHOSPHORUS SOURCE FOR PLANKTON ALGAE,
Texas A and M Univ., College Station. Dept. of Biology.
Walter Abbott.
Ecology, Vol 38, No 1, p 152, 1957.

Descriptors: *Phosphorus compounds, *Phytoplankton, *Water pollution sources, *Cycling nutrients, Algae, Analytical techniques, Clay loam, Clays, Colloids, Eutrophication, Impoundments, Lakes, Loams, Reservoirs, Texas.
Identifiers: Harris County, Tex, Polyphosphates, Organic phosphates.

Although Lake Houston, a newly impounding lake in eastern Harris County, Texas, supports phytoplankton populations fluctuating twenty-fold, phosphate-phosphorus in centrifugate from samples of water from ten stations was not demonstrable by a technique sensitive to 1 gamma/liter. In a series of 18 samplings, water containing colloidal matter, after oxidation with perchloric acid, contained a mean of 85 gamma/liter (range, 32-285), highest values occurring immediately after heavy rains. Filtrate from passage through Seitz no. 14 filter, similarly treated, showed only barely detectable traces of phosphate-phosphorus. Author offers these data as evidence that planktonic algae may derive nutritive phosphorus from complex polyphosphates or in the suspended colloidal clay, originating from soils of surrounding watersheds, without benefit of intermediate stage of dissolved phosphate. (Eichhorn-Wis)
W69-04800

CAIRO PICKLE CO V MUGGRIDGE (BRINE DISPOSAL POLLUTION BY UPPER RIPARIAN OWNER).
For primary bibliographic entry see Field 06E.
W69-04857

COMMONWEALTH EX REL SHUMAKER V NEW YORK AND PENNSYLVANIA CO, INC (JURISDICTION OF SANITARY WATER BOARD OVER STREAM POLLUTION).
For primary bibliographic entry see Field 06E.
W69-04887

MONTGOMERY LIMESTONE CO V BEARDEN (ACTION TO ENJOIN POLLUTION OF A STREAM BY QUARRY OPERATION).
For primary bibliographic entry see Field 06E.
W69-04911

SPARTAN DRILLING CO V BULL (INJUNCTION TO CURE SALT WATER POLLUTION AND INSECT BREEDING).
For primary bibliographic entry see Field 06E.
W69-04914

WATER POLLUTION BY OUTBOARD MOTORS,
State Univ. of New York, Albany. Atmospheric Sciences Research Center.
For primary bibliographic entry see Field 02H.
W69-04936

THERMAL DISCHARGE BIBLIOGRAPHY,
State Univ. of New York, Albany. Atmospheric Sciences Research Center.
Mark W. Fenlon, Ronald Stewart, and Anne Hutchinson.
Final Rep No 3-The Role of Langmuir Circulation in Mixing of Lake George. Atmos Sci Res Center Pub No 61, pp 53-68, Aug 1968. 16 p, 106 ref. Grant 14-01-0001-1036. OWRR B-008-NY (5).

Descriptors: *Bibliographies, *Thermal pollution, *Pollution abatement, Heated water, Thermal powerplants, Temperature, Publications.
Identifiers: Thermal pollution bibliography (1967-68).

A bibliography of articles, lectures and other references to thermal discharges published in 1967 and early 1968 is presented. Control of discharge of heat into the atmosphere and water, and the possibilities of using waste heat for beneficial purposes are stressed. (Knapp-USGS)
W69-04937

ORGANIC POLLUTION OF NEW YORK HARBOR APPLICATION,
J. S. McCabe.
Water Pollution Control Federation, Journal, Vol 34, No 10, 1962, pp 987-998.

Descriptors: *Water pollution, *Dissolved oxygen, *Harbors, *New York, *Sampling, *Analytical techniques, Mathematical models, Mathematical studies, Model studies, Appalachian Mountain region, Geographical regions, Great Lakes region, Northeast U. S., Forecasting, Regions, Hudson River, Bodies of water, Rivers, Running waters, Streams, Surface waters, On-site investigations.

The relation between pollution and dissolved oxygen in the New York Harbor is reviewed. Field sampling programs and analytical studies are included in the review. Reference is made to a study conducted in 1960 which developed a mathematical model for predicting the dissolved oxygen

profile from the city line on the Hudson River to the Narrows.
W69-05026

ORGANIC POLLUTION OF NEW YORK HARBOR - THEORETICAL CONSIDERATIONS,
D. J. O'Connor.
Water Pollution Control Federation, Journal, Vol 34, No 9, September, 1962, p 905.

Descriptors: *Mathematical studies, *Biochemical oxygen demand, *Dissolved oxygen, *New York, *Hudson River, Treatment facilities, Oxygen demand, Appalachian Mountain region, Great Lakes region, Streams, Bodies of water, Rivers, Surface waters, Running waters, Northeast U. S., Regions, Geographical regions, Harbors.

The author presents a mathematical treatment of dissolved oxygen in the Hudson River and Upper Bay with respect to BOD loading from the various waste treatment plants. There is a good agreement between the observed values of dissolved oxygen and BOD to those obtained by using the mathematical model. Minimum dissolved oxygen occurred at the battery.
W69-05034

OXYGEN BALANCE OF AN ESTUARY,
D. J. O'Connor.
Journal of the Sanitary Engineering Division, Vol 86, No SA3, May, 1960, pp 35-55.

Descriptors: *Biochemical oxygen demand, *Dissolved oxygen, *Mathematical models, *Delaware River, Surface waters, Streams, Running waters, Rivers, Reaeration, Bodies of water, Interstate rivers, Mathematical studies, Model studies, Organic matters, Aeration, Aquatic plants, Aquatic life, Plants, Oxygen demand.

The dissolved-oxygen profile of rivers depends on the concentration of the organic material, its rate of oxidation, and the resulting rate of reaeration. The inter-relationship among geophysical and biochemical factors is described by a differential equation under a steady state condition. The proposed formulas defining the biochemical oxygen demand (BOD) decay and oxygen balance in an estuary agree reasonably with the observed data from the Delaware and James Rivers. The dissolved-oxygen profiles are more consistent and in better agreement than the BOD decay for these examples.
W69-05035

THE CALCULATION OF POLLUTION OF THE THAMES ESTUARY AS A THEORY OF QUANTIZED MIXING,
W. S. Preddy, and B. Webber.
International Journal of Air and Water Pollution, Vol 7, No 8, 1963, pp 829-843.

Descriptors: *Water quality, *Mathematical models, *Water pollution, *Mixing, *Foreign countries, Dissolved oxygen, Waste assimilative capacity, Mathematical studies, Model studies, Effluents, Discharge (Water), Organic wastes, Wastes, Thermal pollution, Reaeration, Nitrogen, Gases, Geographical regions, Regions.

This paper describes the mathematical methods which have been used to relate water quality in the Thames Estuary to the amount and nature of organic and thermal pollution discharges, the positions of discharge, rates of waste oxidation, reaeration rates, and the flow of water from tributaries and effluents. Water quality parameters employed are dissolved oxygen, ammoniacal nitrogen, and oxidized nitrogen.
W69-05041

PREDICTION OF TEMPERATURE IN RIVERS AND RESERVOIRS,
Jerome M. Raphael.
Journal of the Power Division, Vol 88, No P02, July, 1962, p 157.

Descriptors: *Thermal pollution, *Mathematical models, *Water temperature, *Weather data, *Inflow, *Discharge (Water), Water pollution, Water types, Heated water, Model studies, Thermocline, Heat transfer, Conduction, Radiation, Temperature, Water properties, Mathematical studies, Transfer, Standing waters, Impoundments, Rivers, Bodies of water, Running waters, Streams, Surface waters, Reservoirs, Lakes.

A procedure is presented for predicting the temperature of various water bodies from weather records, inflow and outflow characteristics, and the surface area and volume of the body of water. The method can be applied to shallow lakes, flowing streams, and detention reservoirs in which the thermocline is absent and water is stirred by wind or current. A numerical method is outlined which combines the atmospheric conditions such as air temperature, relative humidity, cloud cover, wind speed, and barometric pressure on short wave insolation and reflectance, long-wave radiation from atmosphere and water, evaporation, conduction, and advection. An example is given of the use of the method, which is easily adaptable to machine computation. The method should find application in the comparison of temperatures of streams with and without detention reservoirs and in the dissipation of heat from industrial sources in streams and lakes.
W69-05042

MATHEMATICAL MODEL FOR DISSOLVED OXYGEN,
R. V. Thomann.
Journal of the Sanitary Engineering Division, Vol 89, No SA5, October, 1963, pp 1-30.

Descriptors: *Dissolved oxygen, *Mathematical models, *Water quality, Sewage effluents, Mathematical studies, Model studies, Effluents.

A mathematical model for describing the time variation of dissolved oxygen in a finite number of sections in a body of water is presented. Systems analysis techniques are used, and the dissolved oxygen response equations resulting from the imposition of general input forcing functions are derived. Although the model as presented in its general form embodies all types of inputs and is capable of assessing the effects of any one time varying input in one section of the water body on the dissolved oxygen in any other section, the analytical model is presented for the case of DO variations in an estuary.
W69-05058

ESTUARINE WATER QUALITY MANAGEMENT AND FORECASTING,
Robert V. Thomann, and Matthew J. Sobel.
Journal of the Sanitary Engineering Division, Vol 90, No SA5, October, 1964, pp 9-36.

Descriptors: *Systems analysis, *Forecasting, *Water quality control, *Water pollution, Optimization, Linear programming, Water quality, Mathematical studies, Control, Quality control, Dissolved oxygen, Delaware River, Bodies of water, Interstate rivers, Rivers, Running waters, Streams, Surface waters, Water pollution control, Costs.

The basic techniques of systems analysis are applied to describing time and space variations of dissolved oxygen in an estuary. The results of the analysis are applied to the annual variation of dissolved oxygen in the Delaware estuary. The analysis is further extended to include the formulation for optimum (least cost) solutions when specific dissolved oxygen goals are given. This latter approach uses linear programming techniques.
W69-05059

FORECASTING HEAT LOSS IN PONDS AND STREAMS,
C. J. Velz, and J. J. Gannon.
Water Pollution Control Federation, Journal, Vol 32, No 4, April, 1960, p 392.

Descriptors: *Forecasting, *Heat balance, *Thermal pollution, *Water temperature, Thermal properties, Pressure, Physical properties, Vapor pressure, Radiation, Wind pressure, Heated water, Cooling, Water types, Streams, Bodies of water, Water pollution, Circulation, Convection, Evaporation, Industries, Water properties, Running waters, Ponds, Lakes, Standing waters, Hydrologic data, Meteorological data, Temperature.

The authors present a rational method for forecasting expected water temperature conditions in streams and ponds based on probability of occurrence of the controlling meteorologic and hydrologic variables. It is possible to evaluate temperature effects before constructing industries and steam power plants. Basic equations involve effect of evaporation, convection, radiation, atmospheric vapor pressure, wind velocity, and air temperature.
W69-05062

THE OCCURRENCE, EFFECTS, AND FATE OF OIL POLLUTING THE SEA,
For primary bibliographic entry see Field 05C.
W69-05070

MICROBIOLOGIC AND ESCHERICHIA COLI SEROLOGIC TRACING OF MICROBIAL POLLUTION,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
Paul J. Glantz.
Institute for Research on Land and Water Resources, Research Publication No. 56, University Park, Pa., Dec. 1968. 32 pp, 4 fig, 9 tab, 18 ref. 14-01-0001-983. OWRR Project A-010-PA.

Descriptors: *E. coli, *Waste water pollution, *Coliforms, *Aquatic microbiology, Sewage bacteria, Analytical techniques, Sewage effluent.
Identifiers: *Serogroups, *Tracing microbial pollution, Fecal coliform counts, Total coliform counts.

Total and fecal coliform counts of 15 miles of a creek and its tributaries indicated a higher summer and a lower winter level of microbial pollution. Bacteria counts per 100 ml at a number of sampling sites were fairly constant, but had extreme variations at 5-minute intervals on the same day as well as on different days. Serologic identification of the E. coli strains isolated at different sites in the creeks produced a variety of E. coli serogroups. Isolation of a specific E. coli serogroup along the course of the creek was considered evidence of a constant source of pollution. In a forestry plot, percolation of sewage effluent through the soil effectively reduced the number of total and fecal coliforms and led to the disappearance of E. coli serogroups. (Sink-Penn State)
W69-05155

FAIRES V DUPREE (WATER POLLUTION FROM ANIMAL WASTES).

197 SW 2d 735-738 (Ark 1946).

Descriptors: *Arkansas, *Hogs, *Animal wastes, *Water pollution, Cold springs, Farm wastes, Impaired water quality, Public health, Seepage, Damages, Legal aspects.
Identifiers: *Damages (Legal aspects).

Plaintiff brought action for damages resulting from the operation of a hog ranch in an unsanitary manner on land situated adjacent to plaintiff's property. The court found there was insufficient evidence to show an ascertainable monetary loss to plaintiff's spring from defendant's operation of a hog farm near plaintiff's land in such a manner that seepage from garbage washed down filling plain-

tiff's spring, polluting the water, and infecting it with maggots. However, evidence that plaintiff had periods of vomiting, nausea, and general debility presented a question for the jury as to whether plaintiff's illness was caused by the imposition of stench, flies, and filth or whether plaintiff was overstating the corrupting causes. Therefore, case was reversed and remanded for new trial. (Reed-Fla)
W69-05182

SOUTHLAND CO V MCDONALD (POLLUTION OF WATERCOURSE BY ESCAPED CRUDE OIL).

82 So 2d 448-450 (Miss 1955).

Descriptors: *Mississippi, *Water pollution, *Oil wastes, *Effluents, Flooding, Flood damages, Oily water, Natural streams, Organic wastes, Industrial waste, Oil reservoirs, Overflow, Pastures, Legal aspects, Judicial decisions.
Identifiers: *Game and Fish Comm'n Certificate, Refineries.

Plaintiff brought action for damages for pollution of watercourse caused by crude oil, which had escaped from defendant's refinery. Following the escape of large quantities of oil, plaintiff's land was overflowed and was covered in spots with this substance, and was ruined as pasture land for which it had been previously utilized. The court found that evidence that pollution had continued after notice by plaintiff and others to defendant supported an award of punitive damages. Further, a State Game and Fish Commission Certificate that, as of a date prior to the period sued for, defendant had been complying with rules and regulations on industrial waste effluent had no evidentiary value and was properly excluded. (Reed-Fla)
W69-05186

UNITED FUEL GAS CO V SAWYERS (WELL POLLUTION THROUGH PERCOLATING WATERS).

259 SW 2d 466-468 (Ky 1953).

Descriptors: *Kentucky, *Water wells, *Percolating waters, *Reasonable use, Precipitable water, Water pollution, Subsurface waters, Water law, Judicial decisions, Legal aspects, Water rights.
Identifiers: *American rule, Gas wells.

Plaintiff, landowner brought suit against gas company for contamination of a water well alleged to have been caused by a nearby gas well. This court, in reversing a lower court's judgment for the plaintiff, confined its decision to pollution of percolating waters. Percolating waters are those which ooze, seep, or filter through the soil beneath the surface, without a defined channel, or in a course that is unknown and not discoverable from surface indications without excavation for that purpose. Percolating waters are part of the earth itself with the same right of use and appropriation by the owner of the land. Kentucky law is in accord with the 'American Rule' that in the absence of negligence there is no liability if there was a 'reasonable use' of the property. Thus, where a defendant, in a legitimate manner, drilled a gas well on his property, and there was no proof that he should have anticipated injury to a well on plaintiff's adjoining land, nor any question of malice or waste on defendant's part, contamination of plaintiff's well fed by percolating waters was damnum absque injuria. (Reed-Fla)
W69-05187

ROUGHTON V THIELE KAOLIN CO (CHEMICAL POLLUTION BY UPPER RIPARIAN OWNER).

209 Ga 577, 74 S E 2d 844-848 (1953).

Descriptors: *Water pollution, *Georgia, *Riparian rights, *Relative rights, Water rights, Diversion, Industrial wastes, Chemical wastes, Pollution abatement, Prescriptive rights, Reasonable use, Remedies, Damages, Appropriation, Overflow, Legal aspects, Usufructuary right, Judicial decisions, Water law, Soil contamination effects, Non-navigable waters, Obstruction to flow.
Identifiers: Debris.

In 1947, defendant purchased a kaolin plant. Following the custom of the previous owner, he continued to divert the water from an unnamed, non-navigable stream for use in his plant. After such use, the water, polluted with chalk, chemicals and other debris, was returned to its natural channel. In 1950, plaintiff purchased a tract of land downstream from defendant's plant. Defendant's refuse gradually filled up the channel causing the polluted stream to overflow and to damage plaintiff's land. After unsuccessfully requesting abatement of this condition, plaintiff sued for damages. The court sustained defendant's demurrer and dismissed the petition. Plaintiff excepted and prosecuted this appeal. This court reversed the lower court and held plaintiff's allegations sufficient to state a cause of action. Riparian proprietors are entitled to have water come to their land in its natural and usual flow; pollution thereof constitutes trespass. The court held that a grantee, as well as the original owner has standing to seek abatement of the polluting activity and to recover damages. Such action will lie against the person initiating the pollution causing activity or his immediate or remote grantee. An action may be brought if a request to desist is ignored. (Gabrielson-Fla)
W69-05190

5C. Effects of Pollution

THE EFFECT OF PHOTOSYNTHESIS ON THE OXYGEN BALANCE IN A MIDWESTERN STREAM,
Iowa Univ, Iowa City. Dept. of Civil Engineering.
D. B. McDonald, W. L. Paulson, and C. A. Merritt.

OWRR Project A-016-IA. Iowa State Water Resources Res Inst Completion Rep, June 30, 1968. 27 p, 9 fig, 5 tab, 9 ref.

Descriptors: *Dissolved oxygen, *Photosynthesis, *Streams, *Iowa, Aquatic plants, Transpiration, Photosynthetic bacteria, Plankton, Phytoplankton, Oxygen demand, Chemical oxygen demand, Biochemical oxygen demand, Biochemistry, Light, Turbulence, Streamflow.
Identifiers: Iowa River.

The relation of photosynthesis to oxygen concentration in the Iowa River was studied by comparing dissolved oxygen with plankton counts, by plotting diurnal oxygen curves, and by studying photosynthesis in light and dark bottles. Photosynthetic oxygen production exceeds total respiration by a factor of 2. In the Iowa River, plankton counts were less than 500 organisms per ml 23% of the time above a dam in the study reach, and 13% of the time below the reservoir. Although the organic activity and total organic load of the stream are low, the results of study are comparable to studies of other rivers. (Knapp-USGS)
W69-04780

DISTRIBUTION, ENVIRONMENTAL REQUIREMENTS AND SIGNIFICANCE OF CLADOPHORA IN THE GREAT LAKES,
Ontario Water Resources Commission, Toronto, Biology Branch.
For primary bibliographic entry see Field 02H.
W69-04798

CALORIFIC VALUES OF SOME INVERTEBRATES IN LAKE MENDOTA, WISCONSIN,
Wisconsin Univ., Madison. Lab. of Limnology.
For primary bibliographic entry see Field 02H.
W69-04799

ALGAL GROWTH AQUEOUS FACTORS OTHER THAN NITROGEN AND PHOSPHORUS,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.
Kenneth M. Mackenthun, and William Marcus Ingram.
Publication No WP-24, Federal Water Pollution Control Admin, Dept of Interior, Washington, DC, 1966.

Descriptors: *Algae, *Bibliographies, *Eutrophication, *Plant growth, Analytical techniques, Antibiotics, Bioassay, Noron, Calcium, Chlorine, Cobalt, Copper, Ecology, Environmental effects, Grazing, Iron, Manganese, Molybdenum, Plant growth regulators, Predation, Productivity, Trace elements, Sodium, Viruses, Vitamins, Water chemistry, Water pollution control, Water pollution sources, Water quality.
Identifiers: Autoinhibitors, Extracellular products, Hormones, Auxins, Metabolites, Inhibition, Silicon, Vanadium, Zinc, Gallium.

Although researchers have emphasized the role in eutrophication of the major plant nutrients, nitrogen and phosphorus, there is little doubt that other chemical and biotic influences on production of macrophytes and phytophankton are important, though poorly understood. This selected bibliography of 399 entries, compiled for engineers and scientists confronted with applied control investigations related to pollutants, focuses attention on such factors and their effects on algae. The report is organized into sections, as follows, with numbers of citations indicated: general references, 15; antibiotics, 31; autoinhibitors, 11; environmental factors, 25; extracellular products, 31; hormones and auxins, 13; inhibiting metabolites, 24; predation and grazing, 24; general references on trace metals and compounds, 29; boron, 14; calcium, 2; chlorine, 5; cobalt, 7; copper, 5; gallium, 1; iron, 2; manganese, 5; molybdenum, 12; silicon, 7; sodium, 8; vanadium, 3; zinc, 17; mixed elements, 15; viruses and parasites, 11; vitamin assay methods, 22; vitamin occurrence, 22; organismic requirements for vitamins, 27; syntheses of vitamins, 11. Citations are dated from 1903 to 1966, of which 69 citations are from 1960-1966. (Eichhorn-Wis)
W69-04801

MINERAL REQUIREMENTS FOR THE GROWTH OF ANABAENA SPIROIDES IN VITRO,
Oregon State Univ., Corvallis. Dept. of Botany.
Sherry L. Volk, and Harry K. Phinney.
Can J Bot, Vol 46, pp 619-630, May 1968. 4 fig, 4 tab, 67 ref.

Descriptors: *Algae, *Analytical techniques, *Bioassay, *Essential nutrients, *Nutrient requirements, *Phytoplankton, Aquatic algae, Aquatic microbiology, Aquatic productivity, Cyanophyta, Environmental effects, Eutrophication, Limnology, Nitrogen compounds, Nitrogen fixation, Nuisance algae, Nutrients, Phosphorus compounds, Physiological ecology, Plankton, Oregon.
Identifiers: Klamath Lake.

Anabaena spiroides Klebahn isolated from Upper Klamath Lake, Oregon, was cultured in Gerloff's modification of Chu's No 10 medium. Variations of the concentrations of nutrients were studied to determine minimal requirements for maximum growth. Maximum growth in the nutrition tests varied between 30 and 80 mg/litter dry weight. Iron provided in the alkaline-stable chelate ethylenediamine di-ortho-hydroxyphenylacetate was required in lower concentration (0.3 ppm) than in Gerloff's medium (iron citrate, 1.2 ppm). The minimum concentration of nutrients providing for maximum growth: magnesium, 0.125 ppm; phosphorus, 0.52 ppm; calcium, 10 ppm; sulfur, 3 ppm; potassium, 2.5 ppm. Nitrogen was fixed by this organism. Urea inhibited growth (at 16 ppm nitrogen) while glycine might have stimulated growth. Carbonate did not affect growth. No requirement of minor elements was found for the amount of growth attained. (Fitzgerald-Wis)

W69-04802

NITROGEN AND PHOSPHORUS IN WATER; AN ANNOTATED BIBLIOGRAPHY OF THEIR BIOLOGICAL EFFECTS.
Public Health Service, Washington, D. C.

Public Health Service Publication No 1305, Washington, D. C., 1965. 111 pp.

Descriptors: *Bibliographies, *Eutrophication, *Nitrogen compounds, *Nutrients, *Phosphorus compounds, *Water pollution effects, Algae, Animals, Aquatic plants, Biomass, Fertilization, Lakes, Limnology, Midges, Nitrates, Nitrogen, Nitrogen cycle, Nitrogen fixation, Phosphates, Phosphorus, Productivity, Standing crop, Streams, Water Chemistry, Water pollution control, Water pollution sources, Water quality.
Identifiers: Ducks, Nitrate poisoning.

This selected and annotated bibliography of 171 entries was intended by its author for engineers and scientists who are faced with predicting limnological changes resulting from plant nutrient loadings to standing bodies of water, emphasizing critical concentration values for algal development and effects of fertilication upon aquatic life. It is indexed for major categories with numbers of citations indicated as follows: algae, 86; animals, 4; chemistry, 12; eutrophication, 5; artificial fertilization, 32; fertilization by ducks, 4; lakes, 18; midges, 1; nitrate poisoning, 8; nitrogen fixation by algae, 7; nitrogen and phosphorus, 194; organism standing crops, 11; higher aquatic plants, 6; production, 12. Dates cited range from 1918 to 1965 with 70 references from 1960-1965. Publication includes a general introduction, subject index, author index, and lists of definitions and equivalents at both beginning and end of the bibliography. (Eichhorn-Wis)
W69-04805

THE NEW POLLUTION,
Gilbert V. Levin.
For 8 Volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 3, pp 934-41, 1968. Washington, D C: U S Government Printing Office.

Descriptors: *Eutrophication, *Water pollution, *Phosphates, *Nitrogen, Thermal pollution, Sewage effluents, Sludge treatment, Sewage treatment.
Identifiers: *New pollution, *Nutrient pollution, Sunlight, Agricultural runoff.

Like the water it afflicts, the shape of the pollution problem constantly shifts and changes. The relatively recent and unanticipated emergence of nutrient pollution, or eutrophication, as a major problem in lakes and estuaries around the world is a prime example of this characteristic. Ironically, sewage treatment, itself, produces this new form of pollution. Furthermore, the more advanced the degree of sewage treatment, the greater the resulting load of nutritutional pollutants. This is because the organic material present in the sewage is more thoroughly degraded with the result that the subsequent affending nutrients are released as soluble minerals. Of principal concern are phosphate and nitrogen. A number of different approaches have been made toward removing eutrophying minerals from sewage effluent. The principal attempts center upon dissolved nitrate and phosphate. The eutrophication problem has become so acute, and its persistence is so feared, that regulatory action requiring removal of phosphate from sewage effluent has been instituted at several cities in the United States. Any rational approach to solving the eutrophication problem must include control of agricultural runoff. Furthermore, careful ecological studies are needed to determine if the limitation of nutrients will produce or unmask other 'new pollutants.' (Loeb-Rutgers)
W69-04828

SOUTHLAND V AARON (RIPARIAN OWNER'S ACTION FOR DAMAGES FROM OIL WASTE POLLUTION OF STREAM).
For primary bibliographic entry see Field 06E.
W69-04884

DIVELBISS V PHILLIPS PETROL CO (ACTION FOR DAMAGES TO DAIRY HERD BY STREAM POLLUTION).
For primary bibliographic entry see Field 06E.
W69-04902

W G DUNCAN COAL CO V JONES (PRESCRIPTIVE RIGHTS TO MINEWATER POLLUTION).
For primary bibliographic entry see Field 06E.
W69-04915

THERMAL DISCHARGE BIBLIOGRAPHY,
State Univ. of New York, Albany. Atmospheric Sciences Research Center.
For primary bibliographic entry see Field 05B.
W69-04937

1967: AN EXCEPTIONAL YEAR IN THE LIFE OF THE DE BERRE POND (FRENCH),
Centre National de la Recherche Scientifique, Marseille (France). General Biology and Ecology Lab.; EDF Hydraulic Group of South-Alps Region.
A. Kiener, and R. Longuemare.
La Houille Blanche (Rev of French Hydrotech Soc), No 8, pp 725-734, 1968. 10 p, 14 fig, 3 tab, 6 ref.

Descriptors: *Ponds, *Hydrologic properties, *Hydraulic properties, Model studies, Salinity, Temperature, Precipitation (Atmospheric), Water balance, Meteorological data, Winds, Evaporation, Industrial production, Water yield, Water supply, Tidal waters, Springs, Sea water.
Identifiers: France, Durance River, De Berre pond.

Hydrologic, chemical, and biological environments of De Berre pond, located near the city of Martigues, Southeastern France, were analyzed after the introduction of some industrial plants in the lower reaches of the Durance River. A model simulating the general environment of the De Berre pond was also constructed and its operation analyzed. The study shows the considerable effect of climatic, sea-water incursion, and other factors such as the Durance industrial plants, on the hydrologic, chemical, and biological characteristics of the De Berre pond. (Gabriel-USGS)
W69-04958

RISING ACTIVE WATER FLOW IN THE OSIRIS REACTOR POOL (FRENCH),
Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires' Societe Grenobloise d'Etude et d'Applications Hydrauliques (France).
B. Lerouge, J. P. Huffenus, and P. Lambert.
La Houille Blanche, (Rev of French Hydrotech Soc), No 8, pp 711-724, 1968. 14 p, 12 fig, 2 tab.

Descriptors: *Nuclear reactors, *Industrial water, *Hydraulic design, *Ponds, Industrial production, Radioactivity, Energy losses, Model studies, Design criteria, Water storage, Water temperature, Water treatment, Water properties, Water pollution, Irradiation.
Identifiers: *Scale model, France, Grenoble, Nuclear Research Center.

The authors describe the general problems encountered in designing the circulation pattern of the Osiris swimming pool type reactor of 50 MW output, in operation since 1966, and discuss the hydraulic research carried out on a 1:3 scale model at Sogreah, Grenoble. The model tests consisted of the following two phases: (1) a constant-temperature geometrical study using various Reynolds numbers, and (2) a study of the effect of temperature gradients on water density leading to an upward flow of active water in the system. The study shows that pool pollution rates under conditions present in the pool remain at an acceptable level. The tests confirm the reliability of the scale model approach to certain mixed convection problems in reactor operation. (Gabriel-USGS)
W69-04959

POLLUTION OF LONDON'S RIVER,
A. L. H. Gameson.
New Scientist (London), Vol 22, No 389, April, 1964, pp 295-298.

Descriptors: *Foreign countries, *Water pollution, *History, Water pollution sources, Water pollution effects.

The author presents a brief history and description of pollution conditions in the Thames estuary in the vicinity of London, including principal findings of 'a 15 year study of the causes and effects of variations in pollution conditions between Teddington and the sea'. The findings discussed are from a major study report entitled 'Effects of Polluting Discharges on the Thames Estuary', by the Thames Survey Commission and Water Pollution Research Laboratory.
W69-04993

EFFECTS OF HEATED DISCHARGES IN THE TEMPERATURE OF THE THAMES ESTUARY II,
A. L. H. Gameson, L. Hall, and W. S. Preddy.
Combustion, Vol 32, No 7, January, 1961, p 37.

Descriptors: *Mathematical models, *Heated water, *Thermal pollution, Heat transfer, Mixing, Mathematical studies, Model studies, Regions, Water pollution, Water types, Transfer, Tidal effects, Fresh water, Dispersion, Foreign countries, Geographical regions.

The paper presents a mathematical model for Thames Estuary to evaluate the effect of heated discharges on the excess temperature of the estuary. Effects of tidal movement, fresh water movement, process of longitudinal mixing, and dispersion have been used in the model. Three families of curves are prepared to evaluate the temperature distribution at various sections of the estuary due to heat discharging sources at different points of the estuary. Good correlation was achieved between calculated and observed results.
W69-04994

ON OYSTERS AND SULFITE WASTE LIQUOR,
Gordon Gunter, and Jack McKee.
Pollution Control Commission of the State of Washington, February, 1960.

Descriptors: *Oysters, *Water pollution, *Industrial wastes, *Sulfite liquors, *Pulp wastes, *Washington, Pollution abatement, Ecology, Water pollution control, Wastes, Sulfur compounds, Geographical regions, Pacific coast region, Pacific northwest U. S., Animals, Aquatic animals, Aquatic life, Benthic fauna, Benthos, Commercial shellfish, Shellfish, Invertebrates, Marine animals, Mollusks, Regions, Water quality, Standards.

Information dealing with the effects of sulfite wastes from pulp mills on the oyster industry of Washington is reviewed. Recommendations are made to the Pollution Control Commission pertinent to the adaption of water quality standards for water on or near oyster beds.
W69-04997

THE BIOLOGY OF POLLUTED WATERS,
H. B. N. Hynes.
Liverpool, England: Liverpool University Press, 1960.

Descriptors: *Water pollution effects, *Biological communities, *Ecology, Water pollution, Aquatic

environment, Aquatic microbiology, Impaired water quality, Pollutants, Water quality, Environment, Microbiology, Aquatic plants, Aquatic life, Plants, Aquatic animals, Animals, Aquatic habitats, Habitats.

This comprehensive treatment of the biology of polluted waters 'has summarized and codified the information that is available'. The book is largely limited to fresh water, and gives very little consideration to the biology of polluted estuarine waters. With regard to estuarine waters the author concludes that, 'Apart from the effect on migratory fishes there is little detailed information on the biological consequences of estuarine pollution'. The book was evidently written for ready comprehension of the basic principles by the lay reader, and would provide an admirable basic text for the subject of water pollution.
W69-05004

CULTIVATING FISH FOR FOOD AND SPORT IN POWER-STATION WATER,
R. B. Iles.
New Scientist, No 324, January, 1963.

Descriptors: *Thermal pollution, *Beneficial use, *Heated water, *Waste water (Pollution), *Fish stocking, Thermal power, Fish farming, Water sports, Sport fishing, Water pollution, Foreign countries, Geographical regions, Regions, Water types, Effluents, Liquids, Liquid wastes, Wastes, Agriculture, Stocking, Fish establishment, Recreation, Fishing.

The beneficial uses of thermal pollution for fish culture and recreational use are discussed. The possibility of raising of a number of non-indigenous species and ornamental fish in heated effluent is discussed. The author argues that British waters are generally too cold during the winter season to closely approach optimum productivity of fish growth.
W69-05006

ENVIRONMENTAL CHARACTERISTICS OF RARITAN BAY, A POLLUTED ESTUARY,
H. P. Jeffries.
Limnology and Oceanography, Vol 7, 1962, pp 21-31.

Descriptors: *Salinity, *Dissolved oxygen, *Nutrients, *New Jersey, *Water circulation, Temperature, Atlantic coastal plain, Coastal plains, Geographical regions, Northeast U. S., Circulation, Eutrophication.

Temperature, salinity, dissolved O2, PO4-P, and NO3-N in Raritan Bay, New Jersey, were determined over a 16-month period. Each reflects the circulation pattern in which sea water floods along the northern shore, enters a region of mixing with river discharge in the head of the bay, and then ebbs out along the southern shore. A combination of rich nutrient supplies arising from natural and domestic sources, plus a sluggish circulation, efficient nutrient regeneration mechanism, and scarcity of macroscopic algae combine to form an estuarine environment capable of supporting extremely dense plankton populations.
W69-05008

THE EFFECTS OF TEMPERATURE AND SALINITY ON MARINE AND BRACKISH WATER ANIMALS--I. TEMPERATURE,
O. Kinne.
Oceanographers and Marine Biologists Annual Review, Vol 1, No 1, 1963, pp 301-340.

Descriptors: *Salinity, *Temperature, *Bibliographies, *Brackish-water fish, *Marine fish, Ecology, Environmental effects, Chemical properties, Water properties, Water pollution, Marine animals, Animals, Aquatic animals, Aquatic life, Fish, Saline water fish, Wildlife.

The current literature is reviewed with regard to the effects of temperature and salinity on marine and brackish water animals. It is an ecological approach that includes relevant physiological data but excludes purely biochemical or biophysical aspects. It is noted that a complex correlation exists between salinity and temperature, since various antagonistic and synergistic effects have been identified. An extensive bibliography is provided.
W69-05011

STUDIES ON OYSTER MORTALITY IN RELATION TO NATURAL ENVIRONMENTS AND TO OIL FIELDS IN LOUISIANA,
J. G. Mackin, and S. H. Hopkins.
Institute of Marine Science, Publications, Vol 7, July, 1962, pp 1-131.

Descriptors: *Oysters, *Oil wastes, *Mortality, Southeast U. S., Regions, Gulf coastal plain, Animals, Benthos, Aquatic animals, Aquatic life, Benthic fauna, Commercial shellfish, Invertebrates, Marine animals, Mollusks, Shellfish, Geographical regions, Coastal plains, Louisiana, Organic matter, Wastes, Oil industry, Industries, Water pollution, Salinity, Chemical properties, Water properties, Water temperature, Temperature.

Field studies showed that oysters had a consistently high mortality rate throughout the warmer half of the year in the study area, and that mortality rate increased with salinity increase within this area. Within oil fields, the amounts of unsaponifiable carbon tetrachloride extractives were highest (up to 5.8 percent) in mud samples taken near bleedwater outlets and other known centers of pollution, and were correlated wtih high (up to 0.00578 percent) 'pentane and heavier hydrocarbons' as measured independently by a commercial laboratory. 'Hydrocarbon' content of mud and water was no higher in areas of high oyster mortality than in areas of low mortality. Bacteriological studies showed that crude oil and its fractions were rapidly destroyed by bacteria living in Louisiana bay muds. It was concluded that oil production factors of the kinds tested could not be responsible for the oyster mortalities spread throughout the large area where damage was claimed.
W69-05020

EFFECTS OF CIVILIZATION ON STRIPED BASS AND OTHER ESTUARINE BIOTA IN CHESAPEAKE BAY AND TRIBUTARIES,
R. J. Mansueti.
Gulf and Caribbean Fisheries Institute, Proceedings, Vol 14, 1962.

Descriptors: *Striped bass, *Aquatic productivity, *Fertilizer, *Maryland, Marine fish, Estuarine environment, Environmental effects, Productivity, Sport fisheries, Nutrient requirements, Fisheries, Atlantic coastal plain, Appalachian Mountain region, Animals, Aquatic animals, Aquatic life, Fish, Marine animals, Saline water fish, Sea basses, Wildlife, Agricultural chemicals, Bay, Regions, Northeast U. S., Geographical regions, Coastal regions.

The author states that the effects of civilization, some harmful, some wasteful, have not materially reduced the potential productivity of the Chesapeake estuary. The hypothesis is advanced that civilization and striped bass are compatible in that increasing fertilization by man may be directly responsible for the unusual increase in number and magnitude of dominant year classes. The problem of excessive and uncontrolled mineral fertilization in estuaries is discussed in relation to striped bass and other biota.
W69-05021

OBSERVATIONS ON THE RESPONSE OF SOME BENTHONIC ORGANISM TO POWER STATION COOLING,
S. Markowski.
Journal of Animal Ecology, Vol 29, No 2, 1960, pp 349-357.

Descriptors: *Powerplants, *Thermal pollution, *Temperature, *Cooling water, Chemical properties, Ecology, Salinity, Benthos, Aquatic life, Algae, Plants, Water properties, Water temperature, Outlets, Hydroelectric plants, Electric powerplants, Engineering structures, Industrial plants, Structures, Afterbays, Water types, Intakes.

The author reports observations made on the settling of benthonic organisms on experimental slabs placed in the intake and in the outfall water of the power station located at the Cavendish Dock. Data indicate that outfall area is more conducive to growth as the benthonic forms appear earlier than in the intake. No algae growth was found in the intake, but there was very prolific growth in the outfall. Specific composition of benthonic invertebrates were similar in both intake and outfall slabs. In addition, denser animal populations were found in the intake than in the outfall. General characteristics of the environments and the factors introduced by the power station into the aquatic medium are discussed.
W69-05023

ECOLOGICAL EFFECTS OF SEWAGE POLLUTION IN BISCAYNE BAY, FLORIDA: SEDIMENTS AND THE DISTRIBUTION OF BENTHIC AND FOULING MACRO-ORGANISMS,
J. K. McNulty.
Bulletin of Marine Science, Vol 11, No 3, 1961, pp 394-447.

Descriptors: *Benthos, *Water pollution, *Florida, Invertebrates, Amphipoda, Fouling, Stream biology, Ecology, Atlantic coastal plain, Coastal plains, Geographical regions, Gulf coastal plain, Animals, Crustaceans, Sewage disposal, Plants, Bacteria, Sewage disposal, Plants, Bacteria, Sewage bacteria, Regions, Southeast U. S., Marine microorganisms, Aquatic life, Aquatic microorganisms, Microorganisms, Seston, Outlets, Aquatic animals.

Harmful and fertilizing effects of sewage in Northern Biscayne Bay, Florida, were established by the quantitative distribution of benthic and fouling macro-organisms. Harmful effects, as indicated by absence of benthic life, were limited to within 200 yards of sewage outfalls, in greater than average depths. Fertilizing effects, as measured by abundance of benthic life, were most pronounced in a narrow band roughly 200 to 600 yards from sewage sources in shallow water with good tidal circulation and where the bottom consisted of firm sandy mud. The fouling organisms in highly polluted waters (greater than 10,000 MPN) were mainly tubiculous amphipods.
W69-05030

SOME EFFECTS OF SEWER EFFLUENT ON MARINE LIFE,
P. H. Young.
California Fish and Game, Vol 50, No 1, 1964, pp 33-41.

Descriptors: *Marine fish, *Shellfish, *Sewer effluents, *California, *Water pollution effects, Water pollution, Animal pathology, Animals, Aquatic animals, Aquatic life, Fish, Marine animals, Saline water fish, Wildlife, Pathology, Geographical regions, Pacific coast region, Regions, Southwest U. S., Outlets.

The author presents data on the detrimental effect of pollution from sewer-outfalls on certain marine fish and shellfish at a site on the California coast. Trauma in the form of lesions and tumors was very common.
W69-05069

THE OCCURRENCE, EFFECTS, AND FATE OF OIL POLLUTING THE SEA,
Claude E. Zobell.
International Journal of Air and Water Pollution, Vol 7, No 2/3, May, 1963, pp 173-198.

Descriptors: *Water pollution, *Water pollution effects, *Sea water, *Water pollution sources, *Oily wastes, Ships, Oil wells, Saline water, Water types, Oily water, Wells, Wastes, Organic matter, Oxygen sag, Oxygen requirements, Aquatic animals, Aquatic life, Animals, Fish, Wildlife, Aquatic plants, Bibliographies.

A general summary article on occurrence, sources, effects, and fate of oil polluting the marine environment, both naturally occurring and resulting from man's activities. Considers submarine seeps, land drainage, wrecked oil tankers, oil discharges from ships, and 'natural' oily materials as sources. Principal geographic areas of occurrence are identified. The effects of oily wastes related to fire hazard, pollution of recreational beaches, sea birds, oysters and other shellfish, finfish and other fauna, plant-life, bacterial population, oxygen regimen, and in fouling of boats and marine structures are presented. The roles of water movements, suspended solids, bottom and beaches, autoxidation, and bacteria in determining the 'fate' of polluting oil are considered. This article also contains an extensive bibliography on physical, chemical, and biological effects of oil as a pollutant in the marine environment.
W69-05070

A BIBLIOGRAPHY ON PERIPHYTON,
Federal Water Pollution Control Administration, Cincinnati, Ohio. Div. of Pollution Surveillance.
For primary bibliographic entry see Field 10.
W69-05140

FACTORS INFLUENCING RADIOSTRONTIUM ACCUMULATION IN DAPHNIA,
California Univ., Berkeley. Sanitary Engineering Research Lab.; California Univ., Berkeley. School of Public Health.
Donald B. Porcella, Charles E. Rixford, and John V. Slater.
Health Physics, Vol 13, pp 391-399, 1967. 8 fig, 2 tab, 7 ref.

Descriptors: *Daphnia, *Radioecology, *Strontium radioisotopes, Analytical techniques, Calcium, Chlorella, Ecosystems, Food chains, Kinetics, Magnesium, Phytoplankton, Radiochemical analysis, Radioisotopes, Scenedesmus, Water chemistry, Water pollution effects, Zooplankton.
Identifiers: *Radioactive accumulation, *Radioactive uptake, Daphnia magna, Chlorella pyrenoidosa, Scenedesmus quadricauda, Discrimination factor.

Authors studied factors affecting strontium accumulation in daphnid populations (fed algae and bacteria) by analysis for calcium ion and radiochemical determination of radiostrontium (strontium-85). Percentage calcium and strontium in Daphnia relates to organism's size and calcium concentration in water. Equilibrium concentrations (Ec) are expressed as discrimination factor, K, a ratio of concentration factors (strontium:calcium). Despite dependance of daphnid size and growth on feeding, Ec of two elements are little affected by food chain, evidenced by K = 0.64, 0.51, 0.49, 0.51, 0.53 for five Ec (range, 3.2-86.9 milligrams calcium/liter). These values approximate K = 0.58, determined by others for Chlorella, next lower step in food chain. Strontium-85 uptake and release follow first order kinetics. Small Daphnia apparently equilibrate before large ones, probably because these ions accumulate primarily in daphnid carapaces, whereupon uptake depends upon population molting rate. The following model, treating K as constant, approximates observed data: D/W = K (O/C) (1-Exp (-kt)), where D = strontium-85 in counts per minute (cpm) /Daphnia at time, t; W = strontium-85 (cpm/milliliter) in water; 0 = calcium (micrograms/Daphnia); C = calcium (micrograms/milliliter) in water; k = reaction rate (dependent upon daphnid size). Authors suggest that rate of strontium-85 uptake estimates daphnid population's growth rate. (Eichhorn-Wisconsin)
W69-05141

SEASONAL VARIATION IN CONTENT OF NITROGENOUS COMPOUNDS AND PHOSPHATE IN THE WATER OF TAKASUKA POND, SAITAMA, JAPAN,
Tokyo Imperial Univ. (Japan). Geographical Inst.
For primary bibliographic entry see Field 02H.
W69-05142

5D. Waste Treatment Processes

WASTE WATER CONSERVATION AND RENOVATION RESEARCH,
Pennsylvania State Univ., University Park.
Earl A. Myers.
Pap, Amer Soc Agr Eng Winter Meet, Chicago, Ill, Dec 1966. 9 p, 1 fig, 2 tab, 4 ref.

Descriptors: *Waste water, *Waste water treatment, Industrial wastes, *Water conservation, Distribution systems, Groundwater recharge, *Water reuse, Return flow, Effluents, Sanitary engineering, *Reclaimed water, Artificial recharge, Sewage effluents, Chemical analysis, Water quality, Aquifers, Sprinkler irrigation, Irrigation systems.
Identifiers: *Waste water reclamation, *Waste water use, *Renovating, Artificial replenishment.

Conservation of waste water involves return, renovation, recharge, and reuse. An interdisciplinary project at Penn State University involving this 4-R cycle is described. The system involves distributing 500,000 gal/day of chlorinated effluent on a 60-acre disposal area. The return section of the cycle involves all factors in transporting and distributing the waste water. Renovation includes the biological and chemical environment receiving waste water plus methods of monitoring quantity and quality. The section on recharge covers the actual amount and condition of the water returned to the ground-water reservoir. Possible uses and potential problems are mentioned in the section on reuse. The complete 4-R cycle must be considered when treating waste water for ground-water recharge. The return effluent must be uniformly distributed and applied slowly to ensure infiltration and renovation. Adequate biological and chemical treatment must take place year-round in the renovation zone; this zone must not be allowed to deteriorate with use. Recharge quantity is governed by the maximum rate that the soil-plant renovation environment can provide treatment. Continual reuse to make room for recharge water must occur in the more humid areas to permit continuous renovation. (USBR)
W69-04748

DETERMINATION, EVALUATION AND ABATEMENT OF COLOR IN TEXTILE PLANT EFFLUENTS,
Georgia Inst. of Tech., Atlanta. French Textile School.
For primary bibliographic entry see Field 05B.
W69-04756

A COMPARISON OF THE INACTIVATION OF ESCHERICHIA COLI AND POLIOVIRUS IN POLLUTED AND UNPOLLUTED WATERS BY CHLORINATION,
Council for Scientific and Industrial Research, Pretoria, (South Africa).
G. J. Stander, A. F. Marais, E. M. Nupen, and J. R. Hoffman.
For the 8 Volume Proceedings, see Vol 2, No 9, Field 06B, W69-03305. Int Conf on Water for Peace, Wash, D C, Vol 3, pp 670-689, 1968. 20 p, 7 fig, 9 tab, 16 ref.

Descriptors: *Water reuse, *Disinfection, *Chlorination, *Viruses, Water purification, Tertiary treatment, Sewage treatment, E. coli, Public health, Viricides.
Identifiers: South Africa, Poliovirus.

The effects of chlorination on E.coli and Poliovirus were studied experimentally to determine the utility of E.coli as in indicator of disinfection effectiveness. In the first series of the experiments, the effects of various levels of free available chlorine on E.coli and Poliovirus in distilled water at pH 7.4 and room temperature were determined. In the second and subsequent series of experiments, polluted waters such as secondary sewage effluents, humus tank effluent after maturation, sand filtered humus tank effluents and a surface water supply serving a large city, were used. These waters, both before and after conventional flocculation, flocculation-floatation, sand filtration and activated carbon filtration, were chlorinated by varying concentrations of chlorine below as well as above breakpoint levels. The investigations show that attenuated type II poliovirus is more resistant to free available chlorine than is Escherichia Coli I under the conditions described. Chlorination of effluents and polluted waters, both before and after conventional purification to breakpoint levels, is a prerequisite for the destruction of both virus and E.coli in less than five minutes; for secondary effluents, the chlorine dosage required to reach breakpoint level can be 10 ppm and more. Where humus tank effluents, even after sand filtration, are considered as sources of raw water for purification for domestic use, it is essential that conditions of chlorination necessary for the total inactivation of the virus are observed, since a negative E.coli test cannot be said to indicate a virologically pure water. Because of risks involved in placing too much reliance on the viri-and bactericidal properties of chlorine, some form of advanced purification of these effluents such as storage in maturation ponds, denitrification, chemical softening or flocculation-floatation, followed by sand and activated carbon filtration, appears to be essential before chlorination. (Knapp-USGS)
W69-04778

FINANCIAL ASPECTS OF POTABLE WATER AND SEWERAGE SYSTEMS,
Domingo A. Ruiz-Delgado, and J. A. Sanchez-Mora.
For 8 Volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 8, pp 692-697, 1968. Washington, D C: U S Government Printing Office, 6 p.

Descriptors: Financing, Potable water, *Rates, Population.
Identifiers: Sewerage systems, Goals, External financing, Domestic private financing, Earnings of the system, Meterless system.

The paper calls attention to the magnitude of the problem, at the national level, of allocating funds for the construction of necessary projects in order to meet the present need for services and the disheartening prospect of having to apply part of these scarce resources toward subsidizing the operation and maintenance of many of the systems. The authors then consider the rates, which are means of obtaining income to guarantee the maintenance and survival of the systems, as well as their expansion in accordance with the rate of population growth. The rates constitute a simple method, are simple to apply, and are designed to achieve a goal. This goal is defined by the various decisions made in accordance with the laws and regulations controlling these matters and with executive orders. It is for these reasons that the authors believe that these rates must be set in accordance with studies that take into account not only the characteristics peculiar to the system under consideration but also the situation on a national scale and the long-range programs drawn up to reach the foreseen goals. They feel a knowledge of the bases and methods that bring about a determined rate is useful, in order to defend and justify the rate to the public. (Loeb-Rutgers)
W69-04821

MODERN SEWAGE TREATMENT PLANTS--HOW MUCH DO THEY COST.

U. S. Public Health Service, Washington, D. C., 1964.

Descriptors: *Sewage treatment, *Costs, *Treatment facilities, *Sludge treatment, *Filters, Operation and maintenance, Design, Equipment.

This study is based on a tabulation of design and cost information for 1504 sewage treatment projects constructed under the PL-660 program. Treatment processes covered include: (1) Imhoff-tank plants, (2) Imhoff-type plants, (3) primary treatment--separate sludge digestion plants, (4) stabilization ponds, (5) activated sludge plants, (6) trickling filters--separate sludge digestion plants, and (7) trickling filters--Imhoff-type plants.
W69-05031

ESTIMATING SEWAGE TREATMENT PLANT OPERATION AND MAINTENANCE COSTS,
P. P. Rowan, K. C. Jenkins, and D. H. Howells.
Water Pollution Control Federation, Journal, Vol 33, No 2, February, 1961, pp 111-121.

Descriptors: *Sewage treatment, *Operation and maintenance, *Operating costs, *Treatment facilities, *Estimating, Costs, Waste treatment.

Cost data presented in this report represent total annual cost experience for the operation and maintenance of over 300 treatment plants in the contiguous 48 states plus the District of Columbia.
W69-05051

AUTHORITY TO LEVY TAXES FOR STREET IMPROVEMENTS.
For primary bibliographic entry see Field 06E.
W69-05194

5E. Ultimate Disposal of Wastes

FLUID MECHANICS OF DEEP-WELL DISPOSALS,
DeGolyer and MacNaughton, Dallas, Tex.
A. F. Van Everdingen.
Amer Ass Petrol Geol Mem No 10, pp 32-42, Aug 1968. 11 p, 3 fig, 3 tab, 7 ref, 1 append.

Descriptors: *Fluid mechanics, *Groundwater movement, *Injection wells, Porous media, Waste disposal, Groundwater basins, Geologic formations, Aquifers, Pressure head, Hydrostatic pressure, Porosity, Permeability, Fractures (Geology).
Identifiers: Industrial waste injection wells, Well stimulation, Hydraulic fracturing, Acidizing, Well shooting, Reservoir pressure.

The fundamental law which governs the flow of slightly compressible fluids in permeable formations was used to compute three unit functions useful in well or reservoir analysis. These unit functions give quantitative information on (1) the change of pressure in the well or formation as a result of unit rate of injection during a period of time, (2) the amount of fluid which can be disposed of per unit pressure increase in a given time, and (3) the effect of an enlarged borehole on the injection pressure. Accurate prediction of pressures and pressure changes is now possible provided sufficient information is available on the physical characteristics of the formation, the formation fluids, and the injected fluids. The numerical values of these characteristics can vary considerably. To simplify computations, conversion factors are used so that the solutions given here can be used to solve most of the problems irrespective of the numerical values of the characteristics encountered. (Knapp-USGS)
W69-04928

SUBSURFACE DISPOSAL OF LIQUID INDUSTRIAL WASTES BY DEEP-WELL INJECTION,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio. Cincinnati Water Research Lab.
Don L. Warner.
Amer Ass Petrol Geol Mem No. 10, pp 11-20, Aug 1968. 10 p, 2 fig, 58 ref.

Descriptors: *Waste disposal, *Injection wells, *Liquid wastes, Geologic formations, Sandstones, Limestones, Dolomite, Groundwater basins.
Identifiers: Industrial waste injection wells.

Deep-well injection of concentrated, relatively untreatable liquid wastes is discussed. The feasibility of deep-well injection is determined by study of site suitability, waste characteristics, economics, and legal factors. Careful geologic evaluation is necessary to determine site suitability, economics, and suitability of the waste for injection. At least 110 deep industrial injection wells are presently in use, injecting various wastes at widely different rates and pressures into subsurface reservoirs, ranging in age from Pleistocene to Precambrian. Most of the reservoir rocks used are sandstones, limestones, and dolomites. (Knapp-USGS)
W69-04941

IMPORTANCE OF DEEP PERMEABLE DISPOSAL FORMATIONS IN LOCATION OF A LARGE NUCLEAR-FUEL REPROCESSING PLANT,
Oak Ridge National Lab., Oak Ridge, Tenn. Health Physics Div.
Wallace De Laguna.
Amer Ass Petrol Geol Mem No 10, pp 21-31, Aug 1968. 11 p, 3 tab, 11 ref.

Descriptors: *Radioactive waste disposal, *Injection wells, Geologic formations, Aquifers, Mining, Radioactive wastes, Shales, Fractures (Geology), Hydraulic properties, Nuclear wastes.
Identifiers: *Hydraulic fracturing, Salt beds, Krypton-85, High-level wastes, Low-level wastes.

The most important disposal problem in location of a large nuclear-fuel reprocessing plant is that of low-level waste. Disposal into large bodies of surface water was once common, but underground disposal into deep permeable formations seems to offer the best possibilities for disposal of low-level waste. The best method for disposal of medium-level waste is into hydraulically fractured shale, which is generally found in basin areas. A favored method for disposal of high-level waste is storage in solid form in mined cavities in salt. Thus the selection of a site that also has salt beds is advantageous, but not required, because alternate means for disposal of high-level waste can be found. Maximum permissible concentrations of radioactive nuclides in air and water have been determined. As more information is gained, the values may be increased or decreased, and thus may alter the requirements for a plant site. Disposal of radioactive wastes into deep permeable formations is now practicable only for low-level waste, but it holds potential for disposal of certain medium- and high-level wastes, and also of such gaseous wastes as krypton-85. (Knapp-USGS)
W69-04942

POSSIBILITIES FOR DISPOSAL OF INDUSTRIAL WASTES IN SUBSURFACE ROCKS OF NORTH FLANK OF APPALACHIAN BASIN IN NEW YORK,
Shell Canadian Exploration Co., Houston, Tex.; Tidewater Oil Co., Pittsburgh, Pa.; Consolidated Gas Supply Corp., Clarksburg, W. Va.
Thomas P. McCann, Norman C. Privrasky, Frederick L. Stead, and James E. Wilson.
Amer Ass Petrol Geol Mem No 10, pp 43-92, Aug 1968. 49 p, 29 fig, 2 tab, 148 ref.

Descriptors: *Injection wells, *Waste disposal, *New York, Geologic formations, Groundwater basins, Sandstones, Shales, Fractures (Geology), Aquifers, Porosity, Permeability.
Identifiers: Industrial waste injection wells, Appalachian Basin9ny0, hydraulic fracturing, Potsdam Sandstone, Theresa Sandstone, Salt beds.

The north flank of the Appalachian basin in New York was studied to determine the suitability of the region for subsurface disposal of industrial wastes, particularly liquid wastes. Permeable sandstone, salt beds that can provide leak-proof man made caverns, and shale that can contain fluids in artificially produced fractures are especially significant. Subsurface strate dip southward at rates between 50 and 160 ft/mi. Local deformations such as low-relief anticlines and small displacement faults are few. Potential reservoirs for injection of liquids are the Cambrian Potsdam Sandstone, with 100 ft and the Cambrian Theresa Sandstone with a thickness range from 0 to 1,500 ft. Drilling depths to the Potsdam Sandstone, the lowest potential reservoir, range from 1,000 to 12,600 ft. Other possible sandstone reservoirs are present in the Silurian and Devonian Systems, but have less potential because of vagaries in porosity and permeability and because of the possibility of leakage from numerous unrecorded borings in the shallower strata. Salt beds in Silurian rocks at depths between 500 and 4,000 ft offer sites for construction of storage cavities. Shale sections that appear to be suitable for storage of grouted wastes in hydraulically produced fractures are present in Upper Devonian and Upper Ordovician strata. There are thinner sections of possible interest for the same use in Silurian and Middle Ordovician rocks. (Knapp-USGS)
W69-04943

POSSIBILITIES FOR SUBSURFACE WASTE DISPOSAL IN A STRUCTURAL SYNCLINE IN PENNSYLVANIA,
Princeton Univ., N. J. Dept. of Geological Engineering; Atomic Energy Commission, Washington, D. C.
John E. Hardaway.
Amer Ass Petrol Geol Mem No 10, pp 93-127, Aug 1968. 35 p, 14 fig, 4 tab, 99 ref.

Descriptors: *Injection wells, *Waste disposal, *Pennsylvania, Geologic formations, Groundwater basins, Sandstones, Shales, Fractures (Geology), Aquifers, Porosity, Permeability.
Identifiers: Industrial waste injection wells, Bedford (Pa), Synclines, Hydraulic fracturing.

Results of a study of a small structural syncline on the western perimeter of the central Appalachian Mountains of Pennsylvania suggest that the area may be suitable for the injection of liquid wastes into deep subsurface reservoirs. The bowl-shaped syncline forms a basin just north of Bedford, Bedford County, and occupies about 45 sq mi (116.5 sq km) of the county. The total thickness of Paleozoic strata is more than 7,000 ft (2,134 m). The reservoir aquifer considered suitable for disposal is the Lower Silurian Tuscarora Sandstone, a clean quartzose sandstone. The investigation showed that the syncline has sufficient structural closure to warrant consideration as a reservoir. The selected sandstone aquifer crops out along two-thirds of the syncline's perimeter and is approximately 3,700 ft (1,128 m) beneath the center of the basin. It apparently is not faulted, and it may be treated as a confined aquifer because it is bounded by shale and shaly, silty sandstone which probably have much lower permeability. Porosity measurements of Tuscarora and Juniata sandstones gave values of 15 and 10 percent, respectively. The probability of the presence of connate brine in the Tuscarora is enhanced by the fact that it is present in a deep well near Bedford. The Tuscarora strata are described as a 'salaquifer' which will not promote harmful chemical interactions. The shale beds of the area were studied similarly and are regarded as favorable for the injection, into artificially created fractures, of wastes that have been incorporated in cement slurries. However, grouting in shale appears less promising for large-scale injection than disposal in permeable sandstone. (Knapp-USGS)
W69-04944

GEOLOGY OF SUBSURFACE WASTE DISPOSAL IN MICHIGAN BASIN,
Michigan Univ, Ann Arbor.
Louis L. Briggs, Jr.
Amer Ass Petrol Geol Mem No 10, pp 128-153, Aug 1968. 26 p, 18 fig, 3 tab, 12 ref.

Descriptors: *Injection wells, *Waste disposal, *Michigan, Groundwater basins, Geologic formations, Aquifers, Sandstones, Limestones, Shales, Porosity, Permeability, Fractures (Geology).
Identifiers: Michigan basin, Industrial waste injection wells, Synclines, Salt beds.

A study was made of the suitability of rocks in the Michigan basin for disposal of waste by injection wells. The almost circular and symmetrical structural basin contains in the deepest part approximately 14,000 ft of Paleozoic sedimentary rocks. The autogeosyncline developed as a tectonic element in Late Silurian time, during which the middle third of the sedimentary section was deposited. The strato dip generally less than 1 deg toward the center of the basin, although locally there are gentle open folds and a few high-angle fults. The sedimentary formations can be classified into 4 generalized sequences (1) the sandstone sequence of the Cambrian, (2) the carbonate-evaporite sequence of the Ordovician to Middle Devonian, (3) the shale-sandstone sequence of the Late Devonain to Mississippian, and (4) the coal-bearing sequence of the Pennsylvanian. The Cambrian sanstones (Mount Simon) have the most favorable properties for high-volume liquid-waste disposal. They are sutiable thick and reasonable shallow principally in southeastern Michigan near Detroit. The Mount Simon is a typical blanket feldspathic, quartzose sandstone; it is characterized by quartz and feldspar cement, present as grain overgrowths, and detrital and matrix carbonate minerals. Where measured, the porosity averages about 10% and the permeability about 30 md. The Cambrian sandstone beds are overlain by a thick, extensive shale layer (Utica) and salt beds (Salina), which are of secondary importance to liquid- and solid-waste disposal. (Knapp-USGS)
W69-04945

SUBSURFACE WASTE-DISPOSAL POTENTIAL IN SALINA BASIN OF KANSAS,
Augustana Coll., Rock Island, Ill.; Kansas State Geological Survey, Lawrence.
R. W. Edmund, and Edwin D. Goebel.
Amer Ass Petrol Geol Mem No 10, pp 154-164, Aug 1968. 11 p, 7 fig, 11 ref.

Descriptors: *Injection wells, *Waste disposal, *Kansas, Groundwater basins, Geologic formations, Aquifers, Sandstones, Dolomite, Limestones, Shales, Porosity, Permeability.
Identifiers: Salina Basin (Kan), Industrial waste injection wells, Synclines, Salt beds.

The Salina basin, Kansas, was studied to determine its suitability for waste disposal by injection wells. Cambrian sandstones, Pennsylvanian shales, and Permian salt beds are good potential storage reservoirs. The direction of natural fluid flow in the basin appears to be southward. The basin is a simple asymmetric syncline with a uniform gentle southward axial tilt, and is deepest on the SW flank. In most of the basin, Pennsylvanian and Permian rocks crop out. Basin rocks range in age from water is found in all deep porous rocks penetrated by exploratory drilling. (Knapp-USGS)
W69-04946

POTENTIAL OF DENVER BASIN FOR DISPOSAL OF LIQUID WASTES,
Sun Oil Co., Denver, Colo.; Wolf Exploration Co., Dallas, Tex.
George S. Garbarini, and Harry K. Veal.
Amer Ass Petrol Geol Mem No 10, pp 165-185, Aug 1968. 21 p, 12 fig, 1 tab, 47 ref.

Descriptors: *Injection wells, *Waste disposal, *Colorado, Wyoming, Groundwater basins, Geologic formations, Aqufiers, Sandstones, Shales, Porosity, Permeability, Fractures (Geology), Earthquakes.
Identifiers: *Denver Basin, Industrial waste injection wells, Hydraulic fracturing, Synclines, Injection-induced earthquakes.

A reconnaissance subsurface geologic study shows that 3 types of reservoirs are available for liquid-waste disposal in the Denver basin-fractured Precambrian rocks, porous sandstone reservoirs, and thick shale suitable for disposal by the hydraulic-fracturing technique. From early 1962 through early 1966, fractured Precambrian rocks at a depth of 12,000 ft were used as a disposal reservoir for toxic effluent produced at the Rocky Mountain Arsenal near Denver. The disposal well is now shut in, pending investigation of the possible relationship of waste injection to Denver-area earthquakes which increased in frequency and magnitude during the injection period. Sandstone reservoirs most favorable for waste disposal are the Permian Lyons Sandstone, the Triassic Dockum, the Triassic-Jurassic Jelm-Entrada, and sandstones in the Cretaceous Dakota Group and the 'Hygiene zone' of the Pierre Shale. The Lyons, Dockum, and Dakota are best suited for waste disposal in the southern part of the basin. The Dockum sandstone, potentially the best disposal reservoir volumetrically, is limited to the southeast part of the basin. The Jelm-Entrada and Hygiene-zone sandstones are potential disposal reservoirs along the heavily populated strip between Denver and Cheyenne. Cretaceous marine black shale suitable for disposal by the hydraulic-fracturing technique is present everywhere in the basin. The shale crops out over large areas. Beneath the populous strip along the Front Range, the shale is covered locally by as much as 2,000 ft of Upper Cretaceous and Tertiary transitional to continental strata. The basin has good potential for disposal of liquid wastes through wells. (Lang-USGS)
W69-04947

SEDIMENTARY HISTORY AND ECONOMIC GEOLOGY OF SAN JUAN BASIN, NEW MEXICO AND COLORADO,
Montana State Univ., Missoula; El Paso Natural Gas Co., Tex.; Texaco, Inc., Farmington, N. Mex.
James A. Peterson, Allan J. Loleit, Charles W. Spencer, and Richard A. Ullrich.
Amer Ass Petrol Geol Mem No 10, pp 186-231, Aug 1968. 45 p, 24 fig, 61 ref.

Descriptors: *Stratigraphy, *Basins, *Colorado, *New Mexico, *Injection wells, Waste disposal, Groundwater basins, Geologic formations, Aquifers, Sandstones, Shales, Limestones, Porosity, Permeability, Fractures (Geology), Mining, Oil fields, Oil reservoirs.
Identifiers: *San Juan Basin, Industrial waste injection wells, Synclines.

The stratigraphy of the San Juan Basin of Colorado and New Mexico is discussed in detail and the properties of the rocks are reviewed for suitability as waste injection reservoirs. The basin contains up to 15,000 ft of sedimentary rocks from Cambrian to Recent. Development of the area as a sedimentary basin apparently took place in Pennsylvanian time; the basin was maintained with changing rates of subsidence and filling through the remainder of geologic time. Dominantly cyclic marine carbonate deposition during the early phases preceded the infilling of the trough with coarse clastics. The early Mesozoic is characterized by fluvial and eolian environments, interrupted periodically by thin marine transgressive deposits of nearshore redbeds, with a final widespread Late Cretaceous marine thick cyclic sequence of gray shale and sandstone, interbedded with coal. Major reserves of petroleum are in Cretaceous and Pennsylvanian rocks, coal in Cretaceous, and uranium in Jurassic and Cretaceous. Much of the San Juan basin is considered potentially suitable for waste disposal, contingent upon such factors as depth, volume of waste, petroleum and mining activities, present and future groundwater needs, and other industrial and cultural considerations. The Chaco slope probably is the most favorable area for waste disposal. (Lang-USGS)
W69-04948

DISCHARGE OF WASTES INTO THE SEA IN EUROPEAN COASTAL AREAS,
Pierre Koch.
In PROCEEDINGS OF THE FIRST INTERNATIONAL CONFERENCE ON WASTE DISPOSAL IN THE MARINE ENVIRONMENT, University of California at Berkeley, 1959, New York: Pergamon Press, 1960.

Descriptors: *Waste disposal, *Foreign countries, *Coasts, *Water pollution effects, *Oceans, Sanitary engineering, Engineering, Environmental engineering, Geographical regions, Regions, Bodies of water, Surface waters.

The author summarizes information on discharge methods and pollution problems in the marine disposal of effluents. Most European countries are covered in this article. The information is based on reports from experts in these countries.
W69-05015

PROCEEDINGS OF THE FIRST INTERNATIONAL CONFERENCE ON WASTE DISPOSAL IN THE MARINE ENVIRONMENT,
E. A. Pearson.
University of California at Berkeley, 1959, New York: Pergamon Press, 1960.

Descriptors: *Waste disposal, *Hydrography, *Water pollution effects, Environmental sanitation, Water analysis, Foreign countries, Public health, Design, Oceanography, Aquatic life, Engineering, Environmental engineering, Hydrologic aspects, Analysis, Geographical regions, Regions.

Papers were presented in the following subject areas: (1) public health, (2) effects on marine biota, (3) design consideration, (4) nearshore oceanography, (5) receiving water analyses, and (6) estuarine hydrography.
W69-05038

5F. Water Treatment and Quality Alteration

WATER FOR FLUORIDES,
Pan American Health Organization, Washington, D. C.; World Health Organization, Geneva (Switzerland).
Franz J. Maier.
For the 8 Volume Proceedings, see Vol 2, No 9, Field 06B W69-03305. Int Conf on Water for Peace, Wash, D C, Vol 3, pp 748-751, 1968. 4 p.

Descriptors: *Public Health, *Water treatment, *Fluoridation, *Fluorides, Organizations, Investigations, Water supply, Urban sociology.
Identifiers: *Public water supplies.

Despite the fact that controlled fluoride addition to public water supplies has been practiced for over 20 yr, that every study made to evaluate the measure has shown it to be the most effective for reducing dental caries, that no harmful effects whatsoever have ever been observed in over 3000 communities where fluorides are used, and that it is one of the most economical public health measures, progress in adopting it has been remarkable slow. Every dental survey made throughout the world during the past 10 yr has shown that the dental decay prevalence among children is almost 100% in most countries. The number of dentists available to cope with the problem is already most inadequate. The situation is at present becoming progressively worse inasmuch as the population is increasing at a rate faster than the number of dentists. To hasten the extension of fluoridation in urban areas, efforts are being made to reduce the cost of the process by improving the techniques of utilizing fluorspar as a source of fluoride. This mineral is the cheapest source, and is widely distributed throughout the world. In rural areas where many children live in homes with private water supplies which cannot presently be economically fluoridated, studies are being made to fluoridate

school water supplies at levels several times that used in community water supplies. Of all the beneficial public health measures presently used, the fluoridation of public water supplies has been subjected to as thorough investigation of its effectiveness and safety as any other. All of this evidence shows that, if you have a public water supply, it should be fluoridated. (Vorhis-USGS)
W69-04769

FINAL REPORT ON BALITMORE HARBOR STUDY,
Johns Hopkins Univ., Baltimore, Md. Chesapeake Bay Inst.
E. D. Stroup, D. W. Pritchard, and J. H. Carpenter.

Technical Report No. XXVI, December, 1961.

Descriptors: *Waste assimilative capacity, *Water quality, *Harbors, *Maryland, Diffusion, Circulation, Acidic water, Water types, Appalachian Mountain region, Atlantic coastal plain, Coastal plains, Geographical regions, Northeast U. S., Regions, Water pollution effects, Water properties.

This final report describes an investigation which 'concerned itself primarily with the physical description of the waters of Baltimore Harbor and the adjacent portion of Chesapeake Bay, the principal objective being the determination of the mechanisms which bring about flushing of the Harbor and the rate at which this flushing occurs'. The report contains a large collection of descriptive data. The authors conclude that '...the major result of the work can be simply stated: as a result of mechanisms which were not previously recognized, and which have not yet been reported for any other estuarine location, the flushing rate of Baltimore Harbor is substantially more rapid than had previously been estimated. The mean life of the Harbor water, i.e., the average time which any particle of water within the Harbor at any instant may be expected to remain within the Harbor, has been found to be of the order of 10 days; previous estimates placed the mean life at from several times 10 to over 100 days.'
W69-05056

TOWARD THE OPTIMIZATION OF INVESTMENT-PRICING DECISIONS: A MODEL FOR URBAN WATER SUPPLY TREATMENT FACILITIES,
Cornell Univ., Ithaca, N. Y.
Courtney Riordan.
Ph D Thesis, Cornell University, Feb 1969. 304 p, 28 fig, 38 tab, 140 ref, 5 append.

Descriptors: *Dynamic programming, *Decision making, Mathematical models, Annual benefits, Water supply, Water treatment, Project planning, *Water demand, Temporal distribution, Investment, *Pricing, Optimization, Economic efficiency municipal water.
Identifiers: Grid-sampling, Multi-stage expansion, Single-stage expansion.

Two mathematical models were structured to find the optimal time and capacity expansion path of treatment facilities for a hypothetical municipal water supply utility. Both models assumed a linear community demand curve for water which was a function of population, which in turn was a function of time. The objective of both models was to maximize the present value of net community benefits subject to system capacity constraints. A single stage (SS) model was solved by an iterative grid-sampling technique, and then the optimum solution found by calculus techniques once the concavity of the benefit function was verified. A multi-stage (MS) model was solved by a dynamic programming algorithm. A parametric sensitivity analysis was performed on both models. The MS model yielded increased net benefit solutions over the SS model. (Gysi-Cornell)
W69-05128

TOWARD THE OPTIMIZATION OF INVESTMENT-PRICING DECISIONS: A MODEL FOR URBAN WATER SUPPLY TREATMENT FACILITIES,
Cornell Univ., Ithaca, N. Y.
Courtney Riordan.
Ph D Thesis, Chap 4, Cornell University, Feb 1969. 304 p, 28 fig, 38 tab, 140 ref, 5 append.

Descriptors: *Decision making, Mathematical models, Analytical techniques, Annual benefits, Annual costs, *Water supply, Water treatment, Water demand, Temporal distribution, *Pricing, *Project planning, Marginal costs, *Optimization, *Investment, Marginal utility, Water management (Applied).
Identifiers: Grid-sampling, Single-stage expansion.

A single stage capacity expansion model was structured for a hypothetical municipal water supply utility. The objective was to determine the optimal time and size of treatment plant expansion in order to maximize total community net benefits over the planning horizon. Two models were solved, assuming arithmetic and exponential population growth rates respectively, up to an arbitarary population stabilization time. Assumptions included identical linear individual demand curves for water, constant marginal cost of production up to system capacity where it became infinite, and variable pricing which kept aggregate demand equal to system capacity at all times. Grid sampling techniques were used to locate the region of the optimal solution and to establish the concavity of the response surface, and the exact solution found by calculus maximization. A sensitivity analysis was performed on the parameters, and the results discussed. Chapter 4 of a thesis. (Gysi-Cornell)
W69-05129

TOWARD THE OPTIMIZATION OF INVESTMENT-PRICING DECISIONS: A MODEL FOR URBAN WATER SUPPLY TREATMENT FACILITIES,
Cornell Univ., Ithaca, N. Y.
Courtney Riordan.
Ph D Thesis, Chap 5, Cornell University, Feb 1969. 304 p, 28 fig, 38 tab, 140 ref, 5 append.

Descriptors: *Dynamic programming, *Decision making, Mathematical models, Annual benefits, Marginal costs, *Water supply, Water demand, *Pricing, Investment, Timing, Water management (Applied), *Project planning, Marginal utility, Optimization, Municipal water.
Identifiers: Multi-stage expansion.

A multi-stage capacity expansion model was structured for a hypothetical municipal water supply utility. The objective was to find the optimum timing and sizing of treatment plant expansions in order to maximize total community benefits for the planning horizon. The model was solved on a digital computer using a discrete dynamic programming algorithm. Basic assumptions for the model were identical to those used in the single stage expansion model (given in a previous abstract). Exponential and arithmetic population growths problems were solved. Sensitivity analyses on stage time intervals, interest rates, population growth rates and planning horizon lengths were performed. Comparisons of the model results with 'average price costing-even design period' planning methods were made. It was concluded that the multi-stage model (marginal cost pricing) resulted in net benefit increases over the average cost pricing method. Chapter 5 of a thesis. (Gysi-Cornell)
W69-05130

5G. Water Quality Control

EFFECTS OF MULTIPLE USES OF WATERSHEDS ON WATER QUALITY,
Federal Water Pollution Control Administration, Washington, D. C.
For primary bibliographic entry see Field 05B.
W69-04702

DETERMINATION, EVALUATION AND ABATEMENT OF COLOR IN TEXTILE PLANT EFFLUENTS,
Georgia Inst. of Tech., Atlanta. French Textile School.
For primary bibliographic entry see Field 05B.
W69-04756

DEVELOPMENT AND STATUS OF POND FERTILIZATION IN CENTRAL EUROPE,
Wisconsin Univ., Madison. Dept. of Zoology.
John C. Neess.
Trans Amer Fish Soc, Vol 76, pp 335-358, 1949. 24 p, 1 fig, 73 ref.

Descriptors: *Cycling nutrients, *Environmental effects, *Essential nutrients, *Fish, *Fisheries, Algae, Aquatic algae, Aquatic microbiology, Aquatic weeds, Balance of nature, Eutrophication, Fish farming, Fish rood organisms, Fish genetics, Fish handling facilities, Fish management, Limnology, Nitrogen compounds, Nitrogen cycle, Nutrient requirements, Lime, Phosphorus compounds, Physiological ecology, Plankton, Sewage, Sewage lagoons.
Identifiers: Europe.

A review of recent European literature on pond fertilization is offered as a foundation for certain phases of American pond-culture technique. The fertilizing substances, lime, potassium, phosphorus, nitrogen, and carbon, are discussed individually in the light of their usefulness in increasing fish yields and with regard to the important mechanisms through which they are able to effect these increases. European techniques in the employment of fertilizer are described where these are different from corresponding American procedures. In addition, an attempt has been made to integrate divergent aspects of the subject through a consideration of certain fundamentals of trophic metabolism in ponds, the function of pond soils as conservators of nutrients, and microbiological processes relating to the theory of fertilization. A synopsis of the history of pond fertilization in central Europe and a general criticism of research methods are included. (Fitzgerald-Wis)
W69-04804

ECONOMICS OF WATER QUALITY MANAGEMENT,
John F. Timmons, and Merwin D. Dougal.
For 8 Volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 6, pp 667-678, 1968. Washington, D C: U S Government Printing Office, 12 p, 7 fig, 2 tab, 1 append.

Descriptors: Water quality, Water quality control, Natural resources, Water pollution, Costs, Benefits, Control, Water utilization.
Identifiers: Water quality management, Input-output diagram, Competitive relationship, Complementary relationship.

The major purpose of this paper is to identify the articulate water quality problems within an economic framework for (1) maximizing the satisfaction of human wants from the use of water and (2) minimizing the costs of producing these satisfactions, considering both the direct and derived demands for water, including the goods and services water helps produce. A second purpose is to elaborate an economic framework within which water quality problems facing our States and Nation may be analyzed. In pursuing these objectives, the paper journeys into the nature of and the growing demand for water, the economic dimension of water quality problems in relation to physical and structural dimensions, supply and demand characteristics, use interrelationships, and costs and benefits associated with particular uses and use methods. The terms water quality, control, and pollution are defined. (Loeb-Rutgers)
W69-04823

CLARK V LINDSAY LIGHT AND CHEMICAL CO (RIPARIAN RIGHTS IN WATERS OF STREAM).
For primary bibliographic entry see Field 06E.
W69-04858

BENEFIT-COST ANALYSIS AND WATER POLLUTION CONTROL,
R. J. Hammond.
Food Research Institute, Stanford University, Stanford, California, Miscellaneous Publication 13, 1960.

Descriptors: *Cost-benefit analysis, *Water pollution control, *Bibliographies, Direct benefits, Indirect benefits, Economics, Tangible benefits, Intangible benefits, Waste treatment, Pollution abatement, Benefits, Control, Abatement, Water quality control, Quality control.

This report presents the author's opinions regarding benefit-cost analysis as applied to water pollution control. The report delves into the history of benefit-cost analysis and presents a general discussion on its use for the analysis of water resource investment. The author is, in general, pessimistic about the value of benefit-cost techniques in relation to water quality control. An excellent bibliography is included in the report.
W69-04998

OXYGENATION OF BALTIMORE HARBOR BY PLANKTONIC ALGAE,
C. H. J. Hull.
Water Pollution Control Federation, Journal, Vol 35, No 5, 1963, pp 587-606.

Descriptors: *Photosynthesis, *Reaeration, *Waste assimilative capacity, *Oxygen requirements, *Maryland, Self-purification, Water purification, Water treatment, Oxygenation, Appalachian Mountain region, Atlantic coastal plain, Coastal plains, Geographical regions, Northeast U. S., Regions, Harbors.

This paper discusses the contribution of photosynthesis to the oxygen balance and, hence, the waste assimilative capacity of an estuary. A literature review is included. A detailed report is given of the effect of photosynthesis upon the waste assimilative capacity of Baltimore Harbor. Data were collected and analyzed indicating quantities of oxygen produced, but the results were not interpreted directly to provide a measure of overall waste assimilation capacity. It was concluded, however, that the contribution of photosynthesis is greater than is that of reaeration.
W69-05003

BOAT AND MARINA WASTES,
Interstate Commission on the Potomac River Basin, Washington, D. C.
Thomas F. Kelleher.
In PROBLEMS OF THE POTOMAC ESTUARY, January, 1964, pp 60-63.

Descriptors: *Maryland, *Virginia, *Water pollution control, *Marinas, *Recreation wastes, *Legislation, *Water quality control, Water pollution sources, Recreation facilities, Boating, Appalachian Mountian region, Atlantic coastal plain, Coastal plains, Geographical regions, Northeast U. S., Regions, Southeast U. S., Recreation, Wastes, Water sports, Control, Quality control, Income.

Estimates are given for the number of marinas presently in operation in the U. S., their business volume, and the number of people participating in recreational boating. Efforts of the 'boating fraternity' to obtain better pollution control through legislation, research and development, and education are described. A list of conclusions regarding desirable water-quality control programs involving pleasure boats and marinas is included. One significant conclusion is that state and local laws must be sufficiently uniform to permit boat owners and operators to travel from state to state without being challenged on waste treatment equipment aboard.
W69-05009

SOCIO-ECONOMIC ASPECTS OF WATER QUALITY MANAGEMENT,
Allen V. Kneese.
Water Pollution Control Federation, Journal, Vol 36, No 2, February, 1964, pp 254-262.

Descriptors: *Water quality control, *Social aspects, *Values, *Social values, Water policy, Water pollution, Water pollution effects, Recreation, Public health, Benefits, Cost-benefit analysis, Evaluation, Control, Quality control.

The author lists the following concepts as useful in defining the nature of water quality management: (1) A region approach is involved. (2) Multipurpose use is an essential element. (3) Comprehensiveness is essential. (4) A systematic search for alternatives should be involved. (5) Flexible adaptation to existing conditions is necessary. An important element in analysis of water quality alternatives is imputing values to water quality levels for various uses since many of the benefits derived from enhancement of water quality are not measured in the open market. Difficult problems in imputing values occur with recreation, public health, and the general amenities. Techniques with promise in terms of evaluating recreation are under study. Public health is a more difficult problem.
W69-05013

WATER QUALITY IN THE POTOMAC ESTUARY,
Interstate Commission on the Potomac River Basin, Washington, D. C.
Gordon E. McCallum.
Problems of the Potomac Estuary, January, 1964, pp 5-10.

Descriptors: *Water pollution control, *Forecasting, *Biochemical oxygen demand, *Human population, *District of Columbia, *Growth rates, Virginia, Maryland, Population, Appalachian Mountain region, Atlantic coastal plain, Coastal plains, Geographical regions, Northeast U. S., Regions, Southeast U. S., Oxygen demand, cities, Water quality, Rates.

This is a short general discussion of past uses and goals of pollution control in the Potomac Estuary. Implications of population growth for future investment requirements for pollution control in the Washington, D. C., area are discussed. Population projections for 1985 and 2010 are given. The implied biochemical oxygen demand loading resulting after 90 percent BOD reduction in 1985 by treatment plants is estimated.
W69-05027

WATER QUALITY CRITERIA, 2nd EDITION,
Jack Edward, McKee, and Harold W. Wolf.
California State Water Quality Control Board, Sacramento, California, Publication No 3-A, 1963.

Descriptors: *Water quality, *Bibliographies, Water analysis, Water properties, Analysis.

The technical and scientific literature pertaining to water quality is evaluated. An extensive bibliography of 3,827 references is included.
W69-05028

PHILLIPS PETROLEUM CO V HARDEE (LIABILITY FOR DAMAGE BY POLLUTION).
189 F 2d 205-212 (5th Cir 1951).

Descriptors: *Water pollution, *Louisiana, *Damages, *Legal aspects, Irrigation systems, Irrigation ditches, Oil fields, Oil wastes, Brines, Oil industry, Saline water, Judicial decisions.
Identifiers: *Damages (Legal aspects), *Joint and several liability.

Plaintiffs, rice farmers, brought suit seeking to recover for damages to crops and land resulting from salt pollution of a creek used for irrigation purposes. Four oil companies and one pipe line company were named as contributing defendants. The trial judge submitted the case to the jury stating that the suit was against each of the five companies separately and apart. The reviewing court found that the evidence presented was insufficient to establish that the negligence of each company by itself was sufficient to cause damage to the entire rice crop. However, the court ordered a new trial on the basis of error in the trial court's instruction. Plaintiffs would be entitled upon remand to recover for their whole damage against one or all of the companies contributing to the damage if they could produce evidence sufficient to establish that the companies, or any one of them, were negligent and, though acting separately, their negligence combined to produce pollution damage. (Katz-Fla)
W69-05199

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

NOTE ON THE STANDARD ERROR OF THE COEFFICIENT OF SKEWNESS,
Geological Survey, Washington, D. C.
Nicholas C. Matalas, and Manual A. Benson.
Water Resources Research, Vol 4, No 1, pp 204-205, February 1968. 2 p, 1 tab, 2 ref.

Descriptors: Distribution patterns.
Identifiers: Standard error, Coefficient of skewness.

Based on Slade's work in 1936, it has long been considered that a skew coefficient is not reliable if it is computed from a sample of less than 140 items. This limitation is erroneous and has acted as a deterrent to the use of computed frequency distributions. A table of the standard error of the skew coefficient is presented to assess the value of a skew coefficient from any sized sample. This article has relevance to empirical economic and technical engineering work being done in water research areas. (Loeb-Rutgers)
W69-04807

BAYESIAN ANALYSIS OF HAAVELMO'S MODELS,
Columbia Univ., New York.
V. K. Chetty.
Econometrica, Vol 36, No 3-4, pp 582-602, July-October 1968. 21 p, 13 fig, 1 tab, 18 ref, 1 append.

Descriptors: *Distribution patterns, *Probability, *Investment, Markov processes, Regression analysis.
Identifiers: *Bayesian analysis, *Haavelmo's models, *Posterior distribution, Probability density, Conditional distribution, Joint density function.

In this paper, the exact posterior distributions of the parameters of Haavelmo's model I is derived for locally uniform prior distributions. Marginal distributions of the parameters have been obtained for Haavelmo's data. Then the predictive probability density of the model is derived for given values of the exogenous variable, investment. In order to check some of the specifying assumptions, the model is expanded and analyzed under the assumption that the error terms are generated by a first order autoregressive scheme. Exact finite sample results are obtained and the posterior distributions are computed for Haavelmo's data. Conditional distributions of the parameters of the model are computed for given values of the autocorrelation parameter, rho, in order to assess the effects of departures from our specifying assumptions. Another specifying assumption that is examined concerns the exogenous nature of investment. For this, Haavelmo's model II, in which investment is assumed to be endogenous, is used. Posterior dis-

tributions of the parameters of the model are computed for this model. Finally, two different prior distributions reflecting two different views about investment are introduced. The posterior distributions of the same parameter are then used to determine how one's prior belief is modified by the sample information. This article has relevance to simultaneous models of water resources and investigations of the properties of the estimated parameters of the model. (Loeb-Rutgers)
W69-04842

A NOTE ON THE VARIANCE OF A MATRIX,
Rice Univ., Houston, Tex.
David H. Nissen.
Econometrica, Vol 36, No 3-4, pp 603-604, July-October 1968. 2 p, 2 ref.

Descriptors:
Identifiers: *Matrix, *Variance, Covariance, Stacking operator, Kronecker product.

To express the covariance of the elements of a matrix, it is convenient first to rearrange the elements of the matrix into a vector. This note proves a theorem which facilitates computations with such rearrangements. An example of the use of the theorem is provided. This article has relevance to the substantial number of water research projects (e.g. input-output methods) that employ matrix algebra and manipulation in their studies. (Loeb-Rutgers)
W69-04844

NOTE ON THE UNBIASEDNESS OF A MIXED REGRESSION ESTIMATOR,
New South Wales Univ., Kensington (Australia).
N. C. Kakwani.
Econometrica, Vol 36, No 3-4, pp 610-611, July-October 1968. 2 p, 3 ref.

Descriptors: *Regression analysis.
Identifiers: *F class, *Bias, Regression disturbance, Symmetrical distribution.

The present note is a sequel to earlier articles by Suzuki and Nagar and Kakwani which, among other things, deal with the bias of a member of the f class of mixed regression estimates proposed by Theil. Suzuki proved that if the regression disturbances are normally distributed the bias of the member of the f class (for which f = 1/s squared, s squared being the unbiased estimator of sigma squared, the residual variance) is of smaller order than 1/T, where T is the number of observations. Nagar and Kakwani derived the bias of this member of the f class without the assumption of the normality of disturbances and showed that under the normality (or even symmetry) assumption, the bias to order 1/T is zero. In this note the author proves that this member of the f class is, in fact, unbiased provided the disturbances are assumed to be symmetrically distributed. This article is relevant to a large part of water research that employs least squares regression analysis in order to quantify water relations. Since data in the water area (e.g. demand studies) will contain similar error disturbance properties as conventional economic data, this article provides meaningful theoretical implications for the problems of the behavior of the error term. (Loeb-Rutgers)
W69-04845

THE INTERPRETATION AND ESTIMATION OF COBB-DOUGLAS FUNCTIONS,
Wisconsin Univ., Madison.
Arthur S. Goldberger.
Econometrica, Vol 36, No 3-4, pp 464-472, July-October 1968. 9 p, 1 tab, 8 ref.

Descriptors: *Regression analysis.
Identifiers: *Cobb-Douglas function, Linear regression, Conditional median, Conditional mean, Conditional distribution, Logarithmic variable, Disturbance.

For empirical implementation of the Cobb-Douglas function, it is customary to append a multiplicative lognormal disturbance and fit a linear regression in the logarithmic variables. When this is done, attention is shifted (apparently unwittingly) to the conditional median from the conditional mean which is ordinarily the prime target of study. The customary procedure may be modified to provide minimum variance unbiased estimation of the conditional median or conditional mean. The familiar Cobb-Douglas log-log function is often used in empirical production and demand analysis. This article is relevant to econometric analyses of water demand and supply conditions that employ this log-log functional form. (Loeb-Rutgers)
W69-04853

HORIZONTAL DIFFUSION FROM AN INSTANTANEOUS POINT SOURCE DUE TO OCEANIC TURBULENCE,
For primary bibliographic entry see Field 02L.
W69-05036

A REVIEW OF THEORETICAL MODELS OF TURBULENT DIFFUSION IN THE SEA,
For primary bibliographic entry see Field 02L.
W69-05037

MATHEMATICAL MODEL FOR DISSOLVED OXYGEN,
For primary bibliographic entry see Field 05B.
W69-05058

ESTUARINE WATER QUALITY MANAGEMENT AND FORECASTING,
For primary bibliographic entry see Field 05B.
W69-05059

OPTIMUM OPERATIONS FOR PLANNING OF A COMPLEX WATER RESOURCES SYSTEM,
California Univ., Los Angeles. Water Resources Center.
W. A. Hall, R. W. Shepherd, W. S. Butcher, A. M. Esogbue, and S. C. Parikh.
UCLA Engineering Report No 67-54, (University of California, Water Resources Center, Contribution No 122), October 1967. 75 p, 9 figs, 5 tab, 14 ref, 11 flow-charts, 6 photo.

Descriptors: *Computer programs, *Mathematical studies, *Optimizing, *Planning, Water values, Bodies of water.
Identifiers: *Sacramento Basin, *Flow-chart.

The methods used in this report were derived in context with the physical, legal, social, and economic realities of the combined major resource projects in the Sacramento Basin in Northern California. Four major streams, ten reservoirs, and the associated pumping plants, aqueducts, and power generation facilities are included in the analysis. The financial feasibility for planning based on deliveries of firm energy, firm water, off-peak energy, and off-season water is the objective to be maximized. The analysis provides for the specification of the values, within complexly constrained limits, of the firm energy, firm water, dump energy, and dump water to be produced in each of 120 time periods in dry periods (critical periods) at each of the ten reservoirs comprising the five major subsystems. The individual reservoir operators use dynamic programming to optimize their returns. The manager maximizes the actual returns he could obtain from water and power contracts using linear programming. Included in the report are water resource system schematics and programming flow-charts. (Grossman-Rutgers)
W69-05123

TOWARD THE OPTIMIZATION OF INVESTMENT-PRICING DECISIONS: A MODEL FOR URBAN WATER SUPPLY TREATMENT FACILITIES,
Cornell Univ., Ithaca, N. Y.
For primary bibliographic entry see Field 05F.
W69-05128

TOWARD THE OPTIMIZATION OF INVESTMENT-PRICING DECISIONS: A MODEL FOR URBAN WATER SUPPLY TREATMENT FACILITIES,
Cornell Univ., Ithaca, N. Y.
For primary bibliographic entry see Field 05F.
W69-05129

TOWARD THE OPTIMIZATION OF INVESTMENT-PRICING DECISIONS: A MODEL FOR URBAN WATER SUPPLY TREATMENT FACILITIES,
Cornell Univ., Ithaca, N. Y.
For primary bibliographic entry see Field 05F.
W69-05130

OPERATING POLICIES FOR IRRIGATION SYSTEMS UNDER STOCHASTIC REGIMES,
Harvard Univ., Cambridge, Mass.
Russell J. deLucia.
Ph D Thesis, Harvard University, Div Eng Appl Phys, Jan 1969. 173 p, 15 fig, 8 tab, 39 ref, 3 append.

Descriptors: *Linearing programming, *Dynamic programming, *Irrigation systems, *Irrigation efficiency, Water policy, Water management (Applied), Synthetic hydrology, Stochastic processes, Mathematical models.
Identifiers: *Sequential linear programming, Stochastic regimes, Operating policies.

Two distinct mathematical modelling approaches, used to determine optimal operating policies for irrigation systems subject to stochastic regimes, were presented. A dynamic programming model determined the optimal policy for a one-crop system, while a sequential linear programming model determined policy for a multi-crop problem. The algorithms developed could be applied to existing systems for operational decision making, or be used as a planning tool for preproject decision making. The objective of both models was to maximize expected crop revenues as a function of the forecast hydrology subject to technical crop water requirements. (Gysi-Cornell)
W69-05131

OPERATING POLICIES FOR IRRIGATION SYSTEMS UNDER STOCHASTIC REGIMES: DYNAMIC PROGRAMMING MODEL,
Harvard Univ., Cambridge, Mass.
Russell J. deLucia.
PhD Thesis, Harvard Univ, Chap 2, Jan 1969. 37 p, 4 fig, 6 tab, 13 ref.

Descriptors: *Dynamic programming, *Irrigation systems, *Irrigation efficiency, Water policy, Water management (Applied), Synthetic hydrology, Stochastic processes, Storage, Streamflow, Water allocation (Policy).
Identifiers: *Stochastic regimes.

A dynamic programming model was used to determine the optimal operating policy for a one-crop irrigation system under stochastic regime. The objective was to maximize revenue expectation as a function of the forecast hydrology. The model was solved as a non-stationary stochastic, finite stage process problem. State variables were surface storage, previous period streamflow, and water content of root zone. Random variables were streamflow and rainfall during the period. Decision variables were withdrawals from surface and ground storage. Results of the solution compared with a traditional operating policy reported in the literature, indicated an increase in expected value. (Gysi-Cornell)
W69-05132

OPERATING POLICIES FOR IRRIGATION SYSTEMS UNDER STOCHASTIC REGIMES:

SEQUENTIAL LINEAR PROGRAMMING MODEL,
Harvard Univ., Cambridge, Mass.
Russell J. deLucia.
Ph D Thesis, Harvard Univ, Chap 3, Jan 1969. 46 p, 5 fig, 2 tab, 8 ref.

Descriptors: *Linear programming, *Irrigation systems, *Irrigation efficiency, Water policy, Water management (Applied), Synthetic hydrology, Stochastic processes, Water allocation (Policy), Storage, Streamflow.
Identifiers: *Sequential linear programming, *Stochastic regimes, Multi-crop, Multi-season.

A sequential linear programming model was developed to determine optimal irrigation operating policies for the general multi-crop, multi-soil type, with overlapping growing seasons and variable acreage irrigation systems under stochastic regimes. The objective was to maximize revenue expection as a function of forecast hydrology, subject to minimal crop allotment restrictions. Decision variables were the quantity and timing of irrigation water allocation. A particular two-crop system was examined and solved and the results discussed. The model structure approximated on open-loop optimal feedback scheme. A series of coupled linear programs employed a unique activity definition technique for continual consideration of relevant management possibilities. (Gysi-Cornell)
W69-05133

INTRODUCTION TO 'THE CONJUNCTIVE USE OF SURFACE AND GROUNDWATERS',
R. E. Dearlove.
Proc Reservoir Yield Symp, Water Res Ass, Part II, Pap No 10, pp D10-1 to D10-4, Oxford, England, Sept 1965. 4 p, 3 fig.

Descriptors: *Dynamic programming, *Conjunctive use, Surface-groundwater relationships, Benefits, Analytical techniques, Simulation analysis, Water allocation (Policy), Decision making, Optimization.

A paper titled 'The Conjunctive Use of Surface and Ground Waters' (W69-05135) by N. Buras is introduced. Some fundamentals of stochastic inflows, benefit functions for irrigation, and optimization techniques for adoption of decision policies (including simulation) were outlined. State and decision variables for the dynamic programming model by Buras were listed. The recursive methodology of dynamic programming for determining optimal policy by taking optimal sequential decisions was discussed. Figures illustrated the concepts of transition of state variables, and of net benefit functions. (Gysi-Cornell)
W69-05134

THE CONJUNCTIVE USE OF SURFACE AND GROUND WATERS,
Technion - Israel Inst. of Tech., Haifa; California Univ., Berkeley.
N. Buras.
Proc Reservoir Yield Symp, Water Res Ass, Part I, Pap No 10, pp 10-1 to 10-10, Oxford, England, Sept 1965. 10 p, 2 fig, 14 ref.

Descriptors: *Dynamic programming, *Conjunctive use, Aquifers, Computer models, Groundwater recharge, Reservoir operation, Surface-groundwater relationships, Water demand, *Economic efficiency, Water supply, *Water allocation (Policy), Hydrologic budget.

A dynamic programming model was presented which could be used to determine the optimum conjunctive use from surface and groundwater sources. The hypothetical example investigated involved one groundwater source, one reservoir, and one demand area. The decision variables were the source releases, and the recharge from the reservoir to the groundwater. The state variables were the reservoir and aquifer levels. Stochastic inflows from a known probability distribution were assumed. The model assumed independence of inflows. It was concluded that refinements of the model into larger multipurpose systems should be considered. The model could be useful in a sensitivity analysis of a systems design parameter. (Gysi-Cornell)
W69-05135

6B. Evaluation Process

ECONOMIC AND SOCIAL ASPECTS OF PLANNING OF WATER RESOURCES IN DEVELOPING COUNTRIES.
Water Resour J, pp 76-104, Sept 1968. 29 p, 2 ref.

Descriptors: Water resources, *Water resources development, Benefits, Water supply, Planning, *Project planning, *Economic feasibility, Social impact, Economic justification, Cost-benefit analysis, Foreign projects, *Social aspects, Social values, River basin development, Cost repayment, *Irrigation programs, *Financial analysis, Hydroelectric power.
Identifiers: *Developing countries, *Underdeveloped countries, Asia, Development loans, Benefit-cost analysis, Far East.

Economic and social aspects of water resources development planning suited to the countries of Asia and the Far East are reviewed. Many of the planning criteria and standards currently in use originated in the highly developed industrial countries, and are not fully responsive to the needs of the developing countries. A meeting of a Working Group of Experts on Water Resources Planning was organized by the Economic Commission for Asia and the Far East in Sept 1968, and attended by 19 member countries. Topics discussed include: (1) procedures and standards for economic and financial analyses of water resources planning; (2) social and noneconomic considerations in water resources development programs; (3) coordinating activities of all agencies concerned with water resources development and related fields; and (4) other considerations relative to water resources development and related fields. A summary is given of the conference discussions, conclusions reached by the Working Group of Experts on Water Resources Planning, and recommendations for future conferences and seminars. (USBR)
W69-04741

IMPROVEMENT OF WATER RESOURCES UTILIZATION FOR PUBLIC WATER SUPPLY IN TAIWAN,
Taiwan Provincial Government. Public Works Bureau.
Tsu-san Chang.
For the 8 Volume Proceedings, see Vol 2, No 9, Field 06B W69-03305. Int Conf on Water for Peace, Wash, D C Vol 6, pp 758-765, 1968. 8 p, 1 fig.

Descriptors: *Water supply, *Public utilities, *Water allocation (Policy), *Water resources development, Administration, Conjunctive use, Water distribution (Applied), Conservation, Governments, Optimum development plans, Political aspects, Legal aspects, Social aspects, Water utilization.
Identifiers: Taiwan, Public water supply.

The history of public water supply systems in Taiwan is summarized. Only 17% of the population were served with public water supply systems at the end of the Second World War. As of the end of 1965, the total output of the water supply systems in Taiwan has increased to 1,081,600 cu m of water per day to serve 4.84 million people, or 38.3% of its total population. A 10-year plan formulated by the government has a target to raise the population served to 48.5% of the total by the end of 1974. To reach this target, the potable water production shall be increased by additional 607,900 cu m per day. Regional consolidation of water supply systems is being used to achieve effective and coordinated utilization of water resources, enabling the economic and balanced development of water supplies in big cities as well as in small communities. At the same time, the existing water rights have to be honored. Groundwater is abundant in some areas of Taiwan and is preferable to surface water as the source of water supply for nearby communities, industries, and irrigation. Simplicity in treatment and avoidance of long transmission are obvious advantages. In 2 projects, wells were developed to irrigate nearby farms, in exchange for the surface water coming through a long distance canal owned by the local irrigation associations for many years. An appropriate amount of the surface water is then diverted from the canal for the use of public water supplies in communities and industrial districts close to the surface water source. Such schemes require skillful planning; their implementation involves the successful solution of legal, political, and social complications, because the water sources are located in different administrative areas and are owned by different organizations. (Knapp-USGS)
W69-04760

QUALITATIVE ECONOMICS AND THE SCOPE OF THE CORRESPONDENCE PRINCIPLE,
Washington Univ., Seattle; Colorado Univ., Boulder; Kansas Univ., Lawrence.
Lowell Bassett, John Maybee, and James Quirt.
Econometrica, Vol 36, No 3-4, pp 544-563, July-October 1968. 20 p, 21 ref.

Descriptors: Cycles, Stability.
Identifiers: *Qualitative economics, *Correspondence principle, Comparative statics, Morishima matrix, Chains, Sign stability.

The comparative statics properties of qualitatively specified systems are investigated in two cases: the 'purely qualitative' case studied by Lancaster and Gorman, and the case in which the coefficient matrix of the system is assumed to be stable. Samuelson's 'correspondence principle' is shown to be of particular importance in the Morishima case, but of less importance when the Morishima conditions are violated. This article has relevance to multi-equation water resource models that involve qualitative specifications of the system. (Loeb-Rutgers)
W69-04806

DEEP SEA MANGANESE NODULES: FROM SCIENTIFIC PHENOMENON TO WORLD RESOURCE,
Berea Coll., Ky.
David B. Brooks.
Natural Resources Journal, Vol 8, No 3, pp 401-423, July 1968. 33 p.

Descriptors: *Manganese, Resources, Natural resources, Water resources, Mining, Mineral industry, economic efficiency, International waters, Economic feasibility.
Identifiers: *Manganese nodules.

There are manganese-bearing nodules on the floor of the deep ocean basins. While it may not be economic to mine these nodules at present, analysis of alternative manganese resources indicates that they are close enough to the margin to place a ceiling on the long run prices of manganese, nickel and cobalt. Competition for the best deposits of manganese nodules is almost certain to develop once deep sea mining proves feasible so that rights to mine these deposits will acquire value. In this article attention is focused on ways in which institutional forces could be designed so as to promote economic efficiency in deep sea mining. The usefulness of a market to establish the value of exclusive mining rights was emphasized. (Winn-Rutgers)
W69-04810

IMPORTANCE OF THE ECONOMIC FEASIBILITY OF THE WATER SUPPLY AND SEWER SYSTEM PROJECTS,
Jorge C. Wedel.

For 8 volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 6, pp 630-636, 1968, Washington: U S Gov't Printing Office, 7 p.

Descriptors: Economics, Economic feasibility, *Feasibility studies, *Project planning, Feasibility, Sewage disposal, Planning, Standards, Evaluation, Costs, Benefits, *Foreign countries, Financial feasibility.
Identifiers: Latin America, Punta del Este Charter.

When resources are scarce and the needs are great, careful planning is indispensable. When evaluating a proposed project, consideration must be given to the standards and specifications to be used and to the preparation of feasibility studies. Most developing countries do not have complete and adequate standards and specifications and for this reason they often turn for assistance to the more developed countries. However, it must be remembered that standards and specifications are set through experience and observation. Consequently, the environment has a great influence on their establishment. Economic feasibility studies must include a complete study of the proposed project from three viewpoints: (1) proof must be given that the proposed technical solution is most economical; (2) the relative priority of the solution must be justified with respect to other existing problems; (3) the financial feasibility must be established. (Winn-Rutgers)
W69-04811

THE BENEFIT-COST RATIO: CONCEPTIONS AND MISCONCEPTIONS,
William S. Butcher.
For 8 volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 6, pp 681-694, 1968. Washington, D C: U S Government Printing Office, 14 p, 2 fig, 3 tab, 19 ref.

Descriptors: *Cost-benefit ratio, Costs, Benefits, Decision making, Economic efficiency, Direct benefits, Dynamic programming, Linear programming, Computers, Risks, Interest rate.
Identifiers: Secondary benefits, Public investment, Incremental benefit-cost analyses, Economic merit, Computer evaluation.

The benefit-cost ratio, properly used, is the ratio of the change in benefits versus the change in costs which results from pursuing one course of action rather than another. When a benefit-cost ratio is assigned to a single project the comparison is between that project and failure to take any action. The numerical value that is derived when a benefit-cost ratio is calculated, is quite sensitive to what is regarded as a cost or a benefit. For instance, in comparing two projects, if the second is cheaper than the first, this could be regarded as a reduction in comparative cost, or an increase in comparative benefits. Valid comparison between projects is given only by noting if the benefit-cost ratio is greater or less than one. It is an error to assign a meaning to how much greater than one. Usually in comparing project expenditures, the increments of cost under consideration are positive. In these cases the benefit-cost ratio being greater than one indicates an economically efficient additional expenditure. However, when the changes of costs and benefits between projects can be either positive or negative, the normally used criterion must be generalized to take this into consideration. This generalization is useful when making computer evaluations. (Loeb-Rutgers)
W69-04812

THE DEVELOPMENT OF NEW WATER RESOURCES IN THE ECONOMICS OF A TOTAL WATER SYSTEM,
J. M. English, and Nabil El-Rambly.
For 8 volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 6, pp 655-664, 1968. Washington, D C: U S Government Printing Office, 10 p, 3 fig, 9 ref.

Descriptors: *Water resources, Investment, Boundaries, Capital, Planning, Pricing, Demand, Economies of scale.
Identifiers: Development, Total water system, System choices, Optimum decision, Optimum mix, Water-need, Surroundings.

The decision whether to invest in new water supplies and, if so, when, how much, or how long, must be made as to maximize some profitability index of an aggregate system. The development of new water resources for commercial uses has been largely confined to situations which are distinguished by the following common characteristics: (1) the demand greatly exceeds the supply, (2) availability of well-defined high value uses for water, (3) new supplies are the only alternative available or have a distinct advantage in an economic comparison and (4) the demand for water is for small quantities. Under these circumstances it is not difficult to justify the investment. This paper discusses the problem of system choices definition of boundaries, surroundings and their interactions. A methodology for the choice of an optimum decision is presented and the alternative of a mix between the conventional surface supplies and the development of a new resource is introduced. The usual two alternative case is shown to be a special case of the mix alternative. The optimum mix is determined on the basis of maximizing some profitability index, such as an internal rate of return on investment. (Loeb-Rutgers)
W69-04813

REGIONAL WATER RESOURCE DEVELOPMENT IN THE FEDERAL SYSTEM,
Walter Kiechel, Jr.
For 8 volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 5, pp 628-633, 1968. Washington: U S Gov't Printing Office, 6 p, 22 ref.

Descriptors: *Water resource development, Resource development, Federal government, Governments, Water law, Water Resources Planning Act, Water resources, *Water rights, State governments, United States, Federal government, Legal aspects, Interstate compacts, Court decisions, Federal jurisdiction, State jurisdiction.

Water law and the legal institutions involved are for the most part circumscribed by the geographic limits of the political entity on whose authority the particular laws or institutions are dependent. The growing realization that water resources need to be handled on a drainage basin or river system basis requires a reexamination of the ability to accommodate such an approach within the framework of existing laws and legal institutions. An effective national program must be responsive to regional, state, and local needs. The existing legal institutions on all levels must accommodate a comprehensive national program with federal leadership and financing accompanied by meaningful state and local participation. Progress has been made in fashioning mechanisms which will serve the purposes of regional water resource planning through the Water Resource Planning Act of 1965. The challenge today is whether similar progress can be accomplished in the realm of regulation and administration of water resources. (Winn-Rutgers)
W69-04815

THE SOCIAL-ECONOMIC EVALUATION OF WATER RESOURCE PROJECTS,
Philip Sporn, and Abraham Gerber.
For 8 volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 6, pp 731-736, 1968. Washington, D C: U S Government Printing Office, 6 p.

Descriptors: Water resources development, Evaluation, Capital costs, Costs, Interest rate, Loans, Obsolescence, Taxes.
Identifiers: Water resource projects, Subsidies, Opportunity cost, Errors, Water power projects, Technological change.

In this paper the authors discuss the principles that enter into a proper economic analysis of the costs of water power projects. Errors in the economic evaluation of water projects most frequently stem from the use of incorrect capital costs. Economic analyses frequently are made on the basis of capital costs associated with the interest rates on government loans or, in the case of international loans, the interest rates on such loans rather than on the real cost of capital or, in technical terms, the opportunity cost of capital in the particular economy. Frequently such distortions in the economic analyses are inadvertently encouraged in the case of international development loans when such loans are tied to a specific project. The availability of such loans predetermines the type of plant to be built without permitting a choice on the basis of sound economic analysis. Errors in evaluation often are also made because the life of the project is evaluated on the basis of its expected physical durability rather than on its economic life and the value of the output is projected without regard to the outlook for technological change that could affect this value. The basic principles for the evaluation of water projects are independent of the form of the particular economy. (Loeb-Rutgers)
W69-04816

IMPROVED EVALUATION PROCEDURES IN APPALACHIAN WATER RESOURCE PLANNING,
James D. Evans, and Robert W. Harrison.
For 8 volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 6, pp 640-651, 1968. Washington: U S Gov't Printing Office, 12p, 4 ref.

Descriptors: *Appalachian Mountain Region, Geographical regions, Regions, *Planning, *Benefits, Input-output analysis, Governments, Area redevelopment, Economics.
Identifiers: Regional development, *Appalachian Regional Development Act of 1965, Expansion benefits, User benefits, Multiplier.

For the first time in United States directives for water resource planning, the Appalachian Regional Development Act of 1965 directs preparation of a comprehensive plan for water and related resource development specifically to stimulate a lagging economy. If water and other public works are to serve as positive instruments for promoting regional development and growth, they must be planned from the outset to accomplish a new range of goals. The authors discuss this thesis under three headings: the over-all framework; the steps toward project selection; and methods of measuring program and project effects. Under the law the emphasis in public investments shall be in areas with significant potential for future growth and with high expected returns. This requires analysis of the subregional economy, but it also recognizes the role of the region in national development and growth. (Winn-Rutgers)
W69-04817

THE DYNAMIC CHARACTER OF MULTIPURPOSE RIVER DEVELOPMENT: THE TVA EXPERIENCE,
For primary bibliographic entry see Field 04A.
W69-04818

ECONOMICS OF WATER QUALITY MANAGEMENT,
For primary bibliographic entry see Field 05G.
W69-04823

WATER AND ECONOMIC DEVELOPMENT.
World Bank, Washington, D. C.

For 8 Volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. Internationsl Conference on Water for Peace, Vol 8, pp 801-809, Washington, D C, U S Government Printing Office, 1968. 9p.

Descriptors: *Financial analysis, *Irrigation, *Flood control, *Water supply, *Inland waterways, *Hydroelectric power, Feasibility studies, Benefits.
Identifiers: *World Bank, *Capital development projects, Managua.

About half of all Bank Group financing has been for hydroelectric power, railways, ports and waterways, telecommunications and urban water supply--clearly revenue-producing public utilities. Experience in less developed countries clearly indicates that such public utilities will almost invariably fail to meet the needs of economic development unless they are made to pay their own way. Consequently the Bank Group requires especially that rates be established which will cover all operating and maintenance costs, including debt requirements, and produce a surplus which will help finance future extensions; this applies whether the utility is publicly or privately owned. An example of the efficacy of such policies is a small project in Managua, Nicaragua, where the water supply system has been reorganized, modernized and extended with the aid of $3 million credit. As a development institution the World Bank Group must look far beyond the engineering and financial aspects of an irrigation project it considers for financing. There are potential direct benefits to farmers due to realizable cropping patterns, farming methods and the indirect benefits of an irrigation project to the immediate community, the region and the country as a whole may be much greater than those derived by the farmers using the water. A successful project adds to the food supply, reduces need for imports or increases exports, relieves upward pressure on prices, expands the tax base. (Sokoloff-Rutgers)
W69-04825

WATER AND ECONOMIC DEVELOPMENT.
World Bank, Washington, D. C.

For 8 Volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 6, pp 617-25, Washington, U S Gov't Printing Office, 1968, 9 p.

Descriptors: *Financing, *Public utilities, Fresh water, Water supply, Utilities.
Identifiers: Economic development, World Bank, International Development Association.

While fresh water is necessary for economic development, some of the problems in financing its supply and use are insufficiently understood. From the experience of the World Bank certain guidelines of general application for financing public utilities can be derived. First, sound development requires that each project financed by justified in terms of its priority in relation to competing demands for scarce financial and natural resources. The second major guideline concerns financial policies. The Bank has found that revenue producing public utilities will almost invariably fail to meet the needs of development unless they are made to pay their own way. A third requirement is the availability of a competent engineering organization, subject to effective policy supervision. Another prerequisite to the successful financing of public utilities is the existence or establishment of appropriate institutional arrangements for their administration. (Winn-Rutgers)
W69-04829

THE ROLE OF INVESTOR-OWNED WATER UTILITIES IN NATIONAL DEVELOPMENT,
William F. Hyland.
For 8 Volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 8, pp 781-85, Washington: U S Gov't Printing Office, 1968.

Descriptors: *Public utilities, Water resource development, Utilities, Return (Monetary).
Identifiers: *Investor-owned water utilities.

There are a number of reasons for encouraging private capital into the area of water resource development. The basic advantage is that it stimulates development. Investor-owned water systems became the pioneers in public utilities in the U S through the default of local governments. None of the governing bodies wanted the responsibility of levying the heavy taxes to raise the necessary capital for construction. Public utility commissions regulate the water service industry. This regulation is considered appropriate in areas of service which are indispensable to the public and where the traditional forces of competition might deny to the public their essential needs. The rate of return established by the utility commission is influenced by the 'comparable earnings' standard and the 'attraction of capital' standard. (Winn-Rutgers)
W69-04830

BASIC DATA FOR WATER PROGRAMMES SOCIAL AND ECONOMIC CHARACTERISTICS FOR WATER PROGRAMMES.
World Health Organization, Geneva (Switzerland).

For 8 Volume Proceedings see Vol. 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 4, pp 833-835, Washington, D C: U S Government Printing Office, 1968. 3 p.

Descriptors: *Data collections, *Water supply, *Water resources development, Social aspects, Construction, Financial feasibility.
Identifiers: *Background information, Urban population.

The planner of a community water supply system will need a large number of basic data in the process of developing a construction programme for water supply which will meet all technical and economic criteria. Some of this information may be called 'background information,' data relating to water quantity and water quality, the physical, geological and ecological characteristics of water systems. The two most important single factors to be considered under this category are the trend of future water requirements, and all those economic criteria which may determine the potential of the prospective water consumer to pay for the water service required. Among the socioeconomic data required by the water supply planner are those relating to population, population growth and distribution of population, present and future industrial activity, income and income distribution, etc. Noteworthy examples for the utilization of social and economic information are two preinvestment surveys carried out under contract with the World Health Organization for the Calcutta Metropolitan District and for the Accra-Tema Metropolitan area in Ghana. (Sokoloff-Rutgers)
W69-04832

CONSIDERATIONS INVOLVED IN THE PLANNING, ORGANIZATION, MANAGEMENT, AND DESIGN OF PUBLIC WATER SUPPLIES,
Harold R. Shipman.
For 8 Volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 8, pp 713-716, Washington, D C, U S Government Printing Office, 1968. 4 p.

Descriptors: *Feasibility studies, Investment, Benefits, Municipal water, Personnel.
Identifiers: *Public water supply program, Revenues, Local conditions, Medium range plan.

In the relatively short time during which the World Bank and its affiliate, the International Development Association, have been engaged in the financing of water systems, the impression has been gained that rather few countries have analyzed their domestic and industrial water supply requirements with other than a short-range goal in mind. It is rare to find a country which has made a comprehensive study of the water supply requirements, consolidated the plans of individual cities and communities, and established the requirements for funds. It is equally rare to find engineering designs and preliminary studies completed to a point where a financing institution can make an appraisal. One of the major reasons why more loans are not being made today is the failure of water supply officials to have projects prepared which could be considered for financing, with preliminary engineering and feasibility studies completed, priorities established, and financing plans reasonably well devloped. (Sokoloff-Rutgers)
W69-04834

THE ROLE OF ECONOMICS IN PLAN FORMULATION,
Daniel V. McCarthy.
For 8 Volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 6, pp 697-702, Washington: U S Gov't Printing Office, 1968, 6 p.

Descriptors: *Economics, *Planning, *Benefits, Cost allocation, Economic justification, Water resource development, Institutional constraints, Annual costs, Annual benefits, Intangible benefits, Data processing.

In deciding the nature and extent of water resource development in any given area or country there are three principal considerations. Common to all project proposals should be the economic justification. The second major consideration involves institutional restraints which may override or otherwise alter plan formulation goals dictated by considerations of economic efficiency. The third consideration includes those intangibles which do not lend themselves to economic evaluation. In general, considerations of economic efficiency will be paramount in underdeveloped countries. As a country develops, the institutional and intangible considerations become more important. The key factor in analyzing the economic efficiency of projects is the measurement of annual costs and benefits. Measuring cost is fairly easy but better procedures are necessary for measuring benefits. (Winn-Rutgers)
W69-04835

FINANCING WATER PROJECTS IN LATIN AMERICA,
W. A. Carter, H. Schulthess, E. Salazar, and Guzman R. Suarez.
For 8 Volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 8, pp 788-796, Washington, D C: U S Government Printing Office, 1968. 9 p, 5 tab.

Descriptors: *Irrigation programs, *Hydroelectric power, *Sewerage, *Water supply, *Loans, Feasibility studies, Electric power.
Identifiers: *Interamerican Development Bank, Technical assistance, Social Progress Trust Fund.

This paper discusses the Interamerican Development Bank, its resources, and its financial operations in the fields of irrigation, sanitation, and hydroelectric power. In the irrigation field, the Bank has financed irrigation projects in Mexico, in Peru, in Chile, in Argentina and in Colombia. These projects have permitted irrigation and improvements on 663,000 hectares of land; the loan total of approximately $175 million is financing projects totalling $482 million and approximately 450,000 people have benefited by this program. In the water supply and sewerage field, the Bank has become the foremost external financial agent for its countries. Its operations are aimed at reaching the goals established by the meeting at Punta del Este in 1961 to provide at least 70% of the urban population and 50% of the rural population with potable water and sewerage by 1971. In the hydropower field, the Bank is involved in 10 hydroelectric projects which will represent an additional 2.35 million KW of generating capacity in 6 countries. The Bank's operations in the Water for Peace Program of the Western Hemisphere are assuming greater and greater importance. In the irrigation and

hydropower fields, these operations supplement national operations. However, in the sanitary field, the Bank has become the primary force in financing water supply and sewerage projects in the member countries. (Sokoloff-Rutgers)
W69-04836

WATER LAW AND PRIVATE DECISION MAKING: A CRITIQUE,
Indiana Univ., Bloomington.
J. W. Milliman.
Jour of Law and Economics, Vol 11, pp 41-63, Oct 1959. 23p.

Descriptors: *Resource allocation, *Reparian rights, *Percolating water, *State jurisdiction.
Identifiers: *Public ownership, *Appropriative rights, *Transferability, Market process, Central planning, Social costs, California, Texas, Colorado, Iowa.

This paper presents a survey and evaluation of state water law as it affects individual decision making processes in the use and development of water resources. The basic thesis is that rights to use water resources should be treated as real property. Insofar as possible, water rights should be defined and given legal certainty so that allocation of water between competing uses and users can take place through the market mechanism. Although the doctrine of appropriation, as presently interpreted, is subject to a number of serious criticisms, it can be modified to provide the foundation for an improved system of water law. The riparian doctrine is ill suited to the development of transferable private property rights in water resources. It places major reliance upon judicial judgment for the allocation of water supplies. Many eastern states are beginning to realize the inadequacies of riparian law and are in the process of moving closer to the doctrine of appropriation, but they are doing so for the 'wrong' reasons. Proposed changes in eastern water law do not stress the opportunities which the appropriation doctrine offers for the development of a price system and individual decision making but rather for the opportunity to institute centralized and non-market decision making processes. The new Iowa law of water rights is an example of this type of thinking. Throughout state water law there seems to be a pervasive distrust of the use of the market mechanism for the allocation of water resources. (Sokoloff-Rutgers)
W69-04839

QUADRATIC TEAMS, INFORMATION ECONOMICS, AND AGGREGATE PLANNING DECISIONS,
Carnegie-Mellon Univ., Pittsburgh, Pa.
Charles H. Kriebel.
Econometrica, Vol 36, No 3-4, pp 530-543, July-October 1968. 14 p, 2 tab, 10 ref.

Descriptors: *Planning, *Decision making.
Identifiers: *Quadratic teams, *Information economics, *Aggregate planning decision, Team decision theory, Objective criterion, Quadratic function.

The construct of team decision theory developed by J Marschak and R Radner provides a useful framework for the conceptualization and evaluation of information within organizations. Quadratic teams concern team decision problems where the organizational objective criterion is represented by a quadratic function of the action and state variables. The purpose of this paper is to explicitly relate the analysis of quadratic team decision problems to recent research in optimal decision rules for aggregate planning--for example, as reported by Holt et al, Theil, van de Panne, and others. A numerical example is presented based on the well known microeconomic model of production and employment scheduling in a paint factory. Water investment decisions, it can be argued, are made in an organizational-team framework and this article can be relevant in relating recent microeconomic theoretical developments to situations in the water investment area. (Loeb-Rutgers)
W69-04843

HOMOGENEOUS, ESPECIALLY LINEAR HOMOGENEOUS, PRODUCTION FUNCTIONS AND THE LAW OF YIELD (GERMAN),
Wuerzburg Univ. (West Germany).
Wolfgang Eichhorn, and Udo Muller.
Weltwirtschaft Archiv, Vol 100, No 2, pp 290-305, June 1968. 16 p, 1 fig.

Descriptors: *Homogeneity, Returns to scale.
Identifiers: *Total yield curves, *Production function, *Linear homogeneous, Factor of production, Euler's Theorem, Monotonic.

The paper is concerned with the question whether the assumption of a homogeneity of production functions agrees with the law of yield, i.e., the law of diminishing returns, or, in other words, whether a theory based both on the law of diminishing returns and on the assumption of production functions being homogeneous to the degree of alpha is free of contradiction. As a result of the research undertaken it may be said that the question may be answered in the affirmative for certain types of returns which are in agreement with the law of diminishing returns (total yield curves); whereas the question must be answered in the negative for a different and important type of returns, also in agreement with the law of diminishing returns where it is a case of alpha greater or equal to one, whether or not the homogeneity is linear. The general questions discussed in this article are relevant to empirical models of water production and cost analyses containing underlying (explicit or implied) linear production functions. (Sokoloff-Rutgers)
W69-04846

CAPITAL ACCUMULATION AND TECHNICAL PROGRESS (GERMAN),
Regensburg Univ. (West Germany).
Winfried Vogt.
Weltwirtschaft Archiv, Vol 100, No 2, pp 185-96, June 1968. 12 p, 2 fig.

Descriptors: *Technology, Investment, Stability, Equilibrium.
Identifiers: *Capital accumulation, *Saving quota, *Technical progress, Production function, Transformation curve, Social product, Growth theory.

The paper offers a contribution to the question of the relationship, within growth theory, between capital accumulation and technical progress. It is assumed that the resources not used for the production of consumption goods may be used either for the production of capital goods or, for the creation of (Harrod-neutral) technical progress in such a manner that an existing transformation curve of accumulation rate and technical progress (conventionally a concave curve) moves to the right with an increasing mathematical product of capital productivity and savings quota. Assuming that entrepreneurs want to maximize the growth rate of profits, one arrives at an optimum-combination of accumulation rate and technical progress for each position of the transformation curve. These assumptions are introduced into a neoclassical growth model, with the aid of which the stability and characteristics of growth equilibrium are examined. It is shown, among other things, that, in contradiction to traditional growth theory, equilibrium rates depend upon the savings quota. Theoretical investment problems in water resources as they concern the rate of capital accumulation, technical progress and the savings behavior of the economy can be fitted into the broad issues treated by this paper. (Sokoloff-Rutgers)
W69-04847

AN ECONOMIC EVALUATION OF ALTERNATIVE METHODS OF FISHERY REGULATION,
Washington Univ., Seattle.
James A. Crutchfield.
Journal of Law and Economics, Vol IV, pp 131-143, Oct 1961. 13 p.

Descriptors: *Fisheries, Welfare, Profit, Taxes, Efficiencies, Pacific Coast Region, Salmon.
Identifiers: *Optimal utilization, *Government regulation, Fishing mortality, Gear restriction, Closed areas, Size limits, Halibut, Closed seasons, Quotas.

In previous papers in the economics of the fisheries, three points have been stressed: the motives which make overfishing a serious problem are essentially economic; if the resource must be exploited under common-property conditions, overfishing is not self-correcting, and government regulation will be required; one of the vital objectives of any regulation must be promotion of economic efficiency. Because this third requirement is foreign to the terms of reference of most regulatory agencies, the economic aspects of regulation have usually been neglected where possible, and ignored where too obvious to be neglected. This paper takes a look at the techniques of fishery management from the standpoint of their economic effects. Assuming that rational utilization of the major Pacific Coast fish populations requires limitation of fishing mortality, the two significant questions studied are: how can this limitation of catch be made effective, and which of the alternative methods will minimize the long-run cost of any given level of output selected. This analysis of this article can be extended to the fishery benefits evaluation of specific water development projects. (Sokoloff-Rutgers)
W69-04849

POSITIVE ECONOMICS, WELFARE ECONOMICS, AND POLITICAL ECONOMY,
Virginia Univ., Charlottesville.
James M. Buchanan.
Jour of Law and Economics, Vol II, pp 124-138, Oct 1959. 15 p.

Descriptors: *Welfare.
Identifiers: *Pareto efficiency, *Social welfare function, Presumptive efficiency, Compensation principle, Mutual gains, Ethical valuations, Subsidization, Utility.

The task of the political economist is that of locating possible flaws in the existing social structure and in presenting possible 'improvements.' The specific hypothesis that mutual gains do exist as a result of possible trades, is tested by the behavior of private people in response to the suggested alternatives. Since 'social' values do not exist apart from individual values in a free society, consensus or unanimity is the only test which can insure that a change is beneficial. In utilizing the traditional 'efficiency' tools it is necessary to beware of slipping into the easy assumption of omniscience. The individual preference patterns and the changes which are based on these must always be considered tentative hypotheses to be subjected to testing in the polling places. The economist can never say one social situation is more 'efficient' than another. In all this he is an ethically neutral observer, and his own evaluations of the alternatives considered do not influence his behavior in any way other than that necessarily arising out of his membership in the group. The above would apply to economists' analysis of investment in public water projects. (Sokoloff-Rutgers)
W69-04852

ACHIEVING PUBLIC ACCEPTANCE OF A RIVER BASIN PLAN,
John T. Starr.
International Conference on Water for Peace, Vol 5, pp 948-954 (1968). 7 p. For 8 volume Proceedings see Vol 2, No 9, Field 06B, W69-03305.

Descriptors: *River basin development, *Interstate commissions, *Project planning, *Adoption of practices, Planning, Coordination, Social function, Political aspects, Social aspects, Area redevelopment, Education, Social participation, Water resources development.

Political and social aspects of river basin improvement plans, which are generally more difficult to deal with than economic or technical problems, are covered. A 'coordinating committee approach' is suggested to anticipate and solve non-technical problems before they thwart or diminish the plans effectiveness. This coordinating committee should represent all the major groups involved in the study of a river basin. Every effort should be made to inform the public what the plan will do for them and what it will cost. General guidelines as to activities which such a committee should include are set forth, and establishment of sub-committees to deal with more specific problems which may be pertinent to a particular river basin plan is recommended. The experience of the coordinating committee of the Susquehanna River Basin Study is outlined as a guide for other plans. (Blunt-Fla)
W69-04861

STATE V PUBLIC SERVICE COMM'N (RECREATION FACILITIES).
275 Wisc 112, 81 N W 2d 71-75 (1957).

Descriptors: *Navigation, *Multiple purpose projects, *Recreation, *Wisconsin, Navigable waters, Parks, Ownership of beds, Lakes, Lake beds, Lagoons, Lake shores, Land use, Landfills, Public benefits, Public lands, Public rights, Water law, Watercourses (Legal aspects), Judicial decisions, Legal aspects.
Identifiers: *Public trust doctrine, Constitutional law.

Wisconsin Laws, ch 282 (1953) authorized the city of Madison to develop a park by filling part of the bed of Lake Wingra, subject to the approval of the Public Service Commission. The city's plans for a park were approved by the Commission, which found that, while the landfill would hinder navigation in the filled areas, overall navigation as well as other public benefits would be improved. At the request of the Conservation Commission, the state instituted a proceeding to review the approval order contending that Wisconsin Laws ch 282 (1953) was unconstitutional as an unlawful delegation of legislative authority without adequate standards and that the public trust under which the state owns and controls lake beds had been violated. The Wisconsin Supreme Court upheld the constitutionality of the statute on the ground that it constituted a proper delegation of legislative authority and also held, after reviewing the Wisconsin Public Trust Doctrine, that the Trust had not been violated by the proposed park. (Carruthers-Fla)
W69-04867

HYDROLOGIC BASES OF WATER RESOURCES UTILIZATION OF LAKES,
Research Inst. for Water Resources Development, Budapest (Hungary).
For primary bibliographic entry see Field 02H.
W69-04957

MASSACHUSETTS MARINE SPORT FISHERIES INVENTORY,
W.-A. Fitzpatrick, and S. Russell.
Massachusetts Division of Fisheries and Game, December, 1961.

Descriptors: *Marine fisheries, *Sport fishing, *Massachusetts, Marine fish, Creel census, Geographical regions, New England, Northeast U. S., Regions, Fisheries, Animals, Aquatic life, Aquatic animals, Fish, Marine animals, Saline water fish, Wildlife, Census, Fishing, Recreation, Water sports, Statistics, Data collections.

Figures are provided for the numbers and kinds of sport-fishing facilities along the Massachusetts coast, the catch-per-unit effort, and the total sport-fishing pressure.
W69-04991

THE GENERAL DEVELOPMENT PLAN FOR THE ALBEMARLE REGION.
Division of Community Planning of the Department of Conservation and Development, North Carolina, November, 1964.

Descriptors: *North Carolina, *Agriculture, *Recreation, *Fisheries, *Forestry, Community development, Appalachian Mountain region, Atlantic coastal plain, Coastal plains, Geographical regions, Regions, Southeast U. S., Income, Human resources, Wildlife, Animals, Land use, Crop production, Transportation.

The Albemarle Area is a block of ten counties bordering Albemarle Sound in northeastern North Carolina. In this report the major economic activities of the area are analyzed (agriculture, forestry, fisheries, recreation). Land use and land potential are studied, including an analysis of major crop productivity in the area. Recreation and wildlife areas are pictured and characterized. Water and overland transportation are also described with development possibilities presented.
W69-04995

THE GULF OF MEXICO MENHADEN FISHERY IN RELATION TO THE SPORTS FISHERY,
Gordon Gunter.
Gulf and Caribbean Fisheries Institute, Proceedings, Vol 16, 1964.

Descriptors: *Sport fishing, *Fishing gear, *Gulf of Mexico, *Commercial fishing, *Competing uses, Commercial fish, Bodies of water, Surface waters, Gulfs, Fishing, Recreation, Water sports, Equipment.

The author argues that the menhaden fisheries do not conflict with estuarine sport fisheries or other commercial fisheries because the fishing gear does not select for the other species of fish, nor does it destroy the estuarine habitat, as alleged.
W69-04996

BENEFIT-COST ANALYSIS AND WATER POLLUTION CONTROL,
For primary bibliographic entry see Field 05G.
W69-04998

PASSAMAQUODDY-ST. JOHN.
HEARING BEFORE A SUBCOMMITTEE OF THE COMMITTEE ON PUBLIC WORKS, U. S. SENATE, 1964. U. S. Government Printing Office, Washington, D. C.

Descriptors: *Tidal energy, *Cost-benefit ratio, *Tidal powerplants, *Cost-benefit analysis, Electric power, Electric powerplants, Engineering structures, Industrial plants, Powerplants, Energy.

This report presents statements made and reports read into the record relating to a Senate hearing on August 12, 1964, concerning the Passamaquoddy-St. John project. A supplemental report on the project from the Department of the Interior is reproduced in whole. The report states that: 'The recommended benefit-cost ratio of the Passamaquoddy Dickey project is 1.47 to 1, of which the Dickey and Lincoln School benefit-cost ratio is 2.25 to 1 and the Passamaquoddy tidal power projects benefit-cost ratio is 1.04 to 1...These benefit-cost ratios were determined for a 100-year period of analysis with interest at three percent.
W69-05005

INVESTIGATION OF THE INTERNATIONAL PASSAMAQUODDY TIDAL PROJECT.
International Joint Commission of the Passamaquoddy Tidal Project, Docket No 72, April, 1961.

Descriptors: *Electric power, *Cost-benefit analysis, *Tidal powerplants, *Economic feasibility, Tidal energy, Energy, Electric powerplants, Engineering structures, Industrial plants, Powerplants, Structures, Feasibility, Indirect benefits, Benefits.

This report presents the detailed results of an investigation by the International Joint Commission if the Passamaquoddy Tidal Power Project. In finding that the Passamaquoddy tidal power project is not economically feasible, the Commission recommended that development of the project be viewed as a long-range possibility having better prospects of realization when other energy resources available are exhausted. The Commission points out that the economic feasibility of the project may be affected by future changes in the costs and benefits considered in the present evaluation of the project. Consideration of the desirability of crediting the tidal project with certain public benefits that have not been included in the economic feasibility determination presented in this report was identified as a possibility. The Commission also recommends that this report be made available to interested parties as a valuable source of relevant engineering and economic data for use in any future study of the possibilities for development of the international tidal power potential of Passamaquoddy Bay.
W69-05007

SOCIO-ECONOMIC ASPECTS OF WATER QUALITY MANAGEMENT,
For primary bibliographic entry see Field 05G.
W69-05013

SEQUENCE AND TIMING IN RIVER BASIN DEVELOPMENT,
John V. Krutilla.
Washington: Resources for the Future, Inc., February, 1960.

Descriptors: *River basins, *Timing, *Sequence, *Water resources development, Cost-benefit analysis, Economic feasibility, Regions, Resource development, Feasibility, Project benefits, Benefits.

This publication discusses the importance of treating the sequence of project development within a river basin as an element to aid in the maximizing of systems benefits. It emphasizes treatment of the river basin system as a whole, rather than a series of independent projects.
W69-05016

ESTIMATED USE OF WATER IN THE UNITED STATES, 1960,
K. A. Mac Kichon, and J. C. Kammerer.
Geological Survey Circular 456, Washington, D. C., 1961.

Descriptors: *Water utilization, *Electric power industry, *Saline water, *Statistics, Geographical regions, Efficiencies, Regions, Industries, Water types, Data collections.

This document provides analysis of water use data originating from several sources. Tables provide estimates of saline water used by the electric power industry. Another provides data by water resources region, e.g., Chesapeake, Ohio, etc. The report states that the use of saline water was doubled between 1955 and 1960.
W69-05019

STRIPED BASS IN MARYLAND TIDEWATER,
R. J. Mansueti, and E. H. Hollis.
National Resources Institute, University of Maryland, Solomons, Maryland, Educational Series No 61, February, 1963.

Descriptors: *Maryland, *Striped bass, *Costs, *Fish conservation, Sport fishing, Commercial fishing, Fishing, Atlantic coastal plain, Appalachian Mountain region, Coastal plains, Geographical regions, Northeast U. S., Regions, Animals, Aquatic animals, Aquatic life, Fish, Marine animals, Marine fish, Saline water fish, Sea basses, Wildlife, Animal

physiology, Competition, Conservation, Surveys, Statistics, Data collections.

A summary of research conducted on the striped bass in Maryland over a ten-year period from 1953 to 1963 is presented. While most of the material concerns the biology of the fish, the most important and valuable fish in Maryland, information on commercial landings from 1887 through 1962 is provided. Beginning in 1959, annual commercial catches of striped bass became very high, averaging about 4,000,000 pounds per year. The retail values were as high as $900,000 annually at the peak of production. Economic surveys of the sport fishery in Maryland indicate variable expenditures and investments. The Potomac survey showed the daily cost per fisherman to range from $1.50 per day to $35.00 per day in the large cruiser-type fishing boats. A discussion of present-day conservation and management methods as well as suggestions for future management and improvement of the fishery are given.
W69-05022

THE CONFLICT BETWEEN FISH AND POWER RESOURCES IN THE PACIFIC NORTHWEST,
M. E. Marts, and W. R. D. Sewell.
Association of American Geographers, Annals, Vol 50, No 1, March, 1960, pp 42-50.

Descriptors: *Electric power, *Commercial fishing, *Pacific northwest U. S., *Competing uses, *Value, Appraisals, Hydroelectric plants, Regulation, Employment opportunities, Geographical regions, Regions, Fisheries, Costs, Efficiencies, Water utilization, Fish conservation, Conservation, Wildlife conservation, Fishing, Industries, Electric powerplants, Engineering structures, Industrial plants, Powerplants, Structures, Afterbays.

This article discusses the relative economic values of fishing and electric power industries and the difficulties inherent in attempting to resolve the conflict. Foremost among the factors which tend to perpetuate the problem are (1) the historic importance of the fishing industry in the Pacific Northwest, (2) inappropriate comparisons of values of fish and power, (3) increasing costs of preserving the fisheries, and (4) the time required to study the biological aspects of the problem. Compromise alternatives to the mutual use of the water resource are given. These include (1) fishing regulation, (2) sanctuary stream programs, (3) the development of runs on non-power streams, and (4) the development of alternative fisheries and the provision of alternative occupations for fishermen.
W69-05024

EMERGING NATIONAL POLICIES GOVERNING OUTDOOR RECREATION IN FEDERAL WATER DEVELOPMENT PROJECTS,
Kenneth C. Nobe.
Journal of Soil and Water, Vol 19, No 2, March-April, 1964, pp 61-66.

Descriptors: *Recreation, *Federal government, *Multiple-purpose projects, *Water resources development, Land management, Projects, Resource development, Management.

The author states that a wide divergence among the policies of federal agencies affecting outdoor recreation components of multiple-purpose water development projects existed until quite recently. Now emerging is a more uniform national policy that recognizes outdoor recreation as a full partner in these projects. But a major job remains: translation of existing and emerging policy into procedures that will result in sound project formulation. The evolution of new recreation policies and their practical implications are discussed in this article.
W69-05033

POLICIES, STANDARDS, AND PROCEDURES IN THE FORMULATION, EVALUATION, AND REVIEW OF PLANS FOR USE AND DEVELOPMENT OF WATER AND RELATED LAND RESOURCES.
Senate Document No 97, 87th Congress, Second Session, U. S. Government Printing Office, May 29, 1962.

Descriptors: *Federal government, *Standards, *Water utilization, *Water resources development, *Land resources, *Costs, Administration, Benefits, Cost analysis, Governments, Analysis, Mathematical studies, Efficiencies, Resources development, Natural resources, Resources, Planning.

The purpose of this document was to establish official Executive policies, standards, and procedures for uniform application in the formulation, evaluation, and review of comprehensive river-basin plans and individual project plans for use and development of water and related land resources. The document describes, in very broad terms, the nature and scope of plans acceptable to the Federal establishment. Definitions are provided for the various benefits arising from water resource investments. Definitions of costs and means for measuring costs are provided. The document provides a very broad framework within which there is much opportunity for wide variations in the applications of the principles set forth.
W69-05039

A SURVEY OF SALT-WATER SPORT FISHING IN VIRGINIA 1955-1960,
C. E. Richards.
Chesapeake Science, Vol 3, No 4, December, 1962, pp 223-235.

Descriptors: *Sport fishing, *Marine fish, *Creel census, *Virginia, *Statistics, Commercial fish, Striped bass, Surveys, Fishing, Recreation, Water sports, Census, Animals, Aquatic animals, Aquatic life, Fish, Wildlife, Appalachian Mountain region, Atlantic coastal plain, Coastal plains, Geographical regions, Regions, Southeast U. S., Marine animals, Saline water fish, Data collections.

A survey of sport fishing in a 1500 square mile area within the Virginia portion of Chesapeake Bay and its tributaries was made from mid-April through October to gain general knowledge of the fishery and its relation to commercial landings. Effort estimates were based on daily boat-counts from a bridge overlooking the York River check area and aerial boat-counts from flights over the entire survey area. Voluntary catch records and interviews were the sources of catch-rate information. Logbook records were generally different from interview records and set catch-rates at a significantly higher level in the areas where both methods were used. Reported sport catches of the four most important commercial food fishes amounted to a low of approximately 8.1 percent in 1955 to a high of 27.2 percent in 1951, of the total catch. The decline of croaker in the catch was severe: 2.2 fish per man-hour in 1955 to 0.2 per man-hour in 1960. A decrease in catch rates of croaker as the number of fishermen aboard party boats increased was noted. Spot catches increased and became the most abundant fish in the fisherman's creel during 1959 and 1960: 1.5 and 2.6 fish per man-hour of fishing. They were also the most abundant fish for 1958, but at a catch rate of 0.8 fish per man-hour. Weakfish or gray sea trout declined from 0.7 fish per man-hour in 1955 to 0.2 fish per man-hour of fishing during 1960. The observed increases in availability of striped bass, puffer, and flounder compared to the declining availability of other fishes is interesting although there may be no connection between these stocks.
W69-05046

THE FUTURE OF ALASKA,
George W. Rogers.
Baltimore, Maryland: Johns Hopkins Press, 1962.

Descriptors: *Commercial fishing, *Economic life, *Alaska, *Industries, Transportation, Navigation, Community development, Geographical regions, Pacific coast region, Regions, Fishing, Oil industry, Erosion, Beach erosion.

Alaska is divided into three major areas, the north-central being the area of interest to the estuary study. The economy of this area has been for some years in a transitory state, due to seasonal labor, rugged weather conditions, and remoteness from markets. Once the principal occupation of the Cook Inlet and Prince William Sound was salmon fishing, but in recent years salmon fishing has declined drastically. More recent emphasis has been on the natural gas and petroleum industries and on defense. The discovery of major oil and gas deposits in the Cook Inlet region has touched off a boom in private oil exploration and development. Knowledge of the physical characteristics of Alaska's tidelands is meager, and coastal and beach erosion are causing serious losses of land and property in some areas. In general, resources in Cook Inlet and Prince William Sound have been sporadically and exhaustively exploited and abandoned. There have been little 'colonization and conservation' efforts, and this remains a problem today. Shipping is limited, since the markets are far away, and there has seemed to be a general trend towards air transport.
W69-05047

ECONOMIC IMPACT OF NARRAGANSETT BAY,
Niels Rorholm.
University of Rhode Island, Agricultural Experiment Station, Kingston, Rhode Island, Bulletin No. 374, December, 1963.

Descriptors: *Economic impact, *Bays, *Rhode Island, *Competing uses, *Cost-benefit analysis, Commercial fishing, Military aspects, Navigation, Transportation, Recreation, Boats, Marinas, Taxes, Government finance, Fishing, Industries, Recreation facilities, Bodies of water, Geographical regions, Regions, New England, Northeast U. S., Value, Management, Efficiencies, Water utilization.

This study presents estimates of the annual 'monetary impact' of the following activities associated with Narragansett Bay: naval installations, general summer sales, ship and boat building, fish landings (commercial), boatyards and marinas, transportation (bridge and ferry only), real estate taxes (on seasonal dwellings), research, and municipal expenditures. It is estimated that these impacts total not less than $145 million per year, of which $132 million is accounted for by naval installation payrolls. The value of the bay in the function of waste disposal is noted. The development of the estimates is explained, as well as their limitations and the importance of conflicts. Management policy recommendations are made for each level of government. Conflicts in use are classified in three types: I--physical space conflicts over a long period, II--physical space conflicts over a short period, and III--conflicts where one use creates a nuisance in relation to another use. It is argued that the best management policy is to increase all uses until conflicts occur, and then make subsequent use decision on the basis of cost-benefit analysis.
W69-05048

SHORELINE RECREATION RESOURCES OF THE UNITED STATES.
For primary bibliographic entry see Field 02L.
W69-05054

INDUSTRIAL FISHERY TECHNOLOGY,
Maurice E. Stansby.
New York: Reinhold Publishing Corporation, 1963.

Descriptors: *Fisheries, *Commercial fishing, *Fish conservation, *Fish harvest, *Fish, Commercial shellfish, Fish handling facilities, Fishing gear, Atlantic menhaden, Salmon, Oysters, Clams, Her-

rings, Marketing, Mollusks, Salmonids, Statistics, Preservation, Equipment, Fish types, Fishing, Industries, Animals, Aquatic animals, Aquatic life, Invertebrates, Shellfish, Facilities, Marine animals, Marine fish, Saline water fish, Wildlife, Benthic fauna, Benthos.

Part I of this book concerns fish characteristics, conservation, statistical data on U. S. and world fisheries from about 1929 through 1959, and fisheries' harvesting methods. Part II is a description of the major fisheries in the U. S. and specific descriptions of the fish species. The 16 most valuable commercial species are discussed in this section. Part III deals with fisheries' by-products, specifically the production of oil and fish meal. Part IV is a discussion of preservation methods employed by U. S. commercial fisheries. Part V discusses the role of modern science as it relates to fisheries technology.
W69-05055

WHAT IS HAPPENING TO OUR ESTUARIES,
Seton H. Thompson.
Twenty-Sixth North American Wildlife and Natural Resources Conference, Transactions, March, 1961, pp 318-322.

Descriptors: *Land reclamation, *Estuarine fisheries, *Economic impact, *Fish harvest, Commercial fishing, Market value, Employment, Fishing, Industries, Fisheries, Value, Beds, Ownership of beds, Coasts, State jurisdiction, Jurisdiction, Federal jurisdiction.

This paper contains a short general discussion of the effects of land reclamation on estuarine fisheries. The author estimates that the estuarine zone of the Gulf and South Atlantic Coasts yields annually about 1.25 billion pounds of fish and shellfish, worth 'upwards of $100 million'. The author suggests the states concerned with the effects of land reclamation in estuaries 'could take three important steps in this direction: (1) Declare a moratorium on the sale of submerged lands. Our troubles begin when these lands fall into private hands. (2) Take inventory to ascertain ownership of all the submerged coastal areas. (3) Establish a Board, similar to a city's zoning commission, to determine the best uses to be made of our coastal waters. The function of this proposed Board would be to develop an overall plan for each segment of our coast and avoid the piece-by-piece type of development we have been experiencing.'
W69-05060

RECREATION--A PURPOSE OF WATER RESOURCES DEVELOPMENT,
Eugene W. Weber.
Civil Engineering, Vol 32, No 9, September, 1962 pp 57-59.

Descriptors: *Recreation facilities, *Recreation demand, *Planning, *Reservoirs, Recreation, Multiple-purpose reservoirs, Demand, Bodies of water, Impoundments, Lakes, Standing waters, Surface waters, Efficiencies, Water utilization, Federal project policy.

Federal reservoirs, which once were constructed for flood control, power development, and water supply, now include recreation as a prime purpose for construction. This was partly due to the demand for recreation at the Corps of Engineers reservoirs which has been increasing at a rate of about three times the annual rate of increase in the nation's GNP and about six times the rate of its population growth. It is now incumbent on planners to insure that: (1) Projections of future needs include estimates of the probable demand for recreation, (2) Projects are designed to minimize loss of existing and inherent recreational values, (3) Projects are designed to permit realization of their recreational potential to the full extent justified by the prospective demand, and (4) Recreation is evaluated on a basis comparable to that used for other project purposes to insure that net benefits, tangible and intangible, for all purposes are maximized.
W69-05067

THE WATER CRISIS,
Frank E. Moss.
New York, Frederick A. Praeger, 1967, 285 pp, 21 map, 2 illus, 1 chart, 78 ref, 1 append.

Descriptors: *Water allocation (Policy), *Water quality, *Water shortage, *Variability, *Planning, *Water resources development, *Political aspects, *Federal government, Estuaries, Water pollution effects, Droughts, Flood damage, Recreation, Wildlife, Water reuse, Research and development, Desalination, Weather modification, Pumping, Institutions.
Identifiers: Depletion.

The first half of this book describes water problems throughout the United States. Without a national water policy, water is allocated and abused according to the strengths of lobbyists. Specific examples are given of the decreasing quality of America's water. Decay of the estuaries and federal contributions to pollution are emphasized. A second problem is water shortage. Moss documents cases of drought from the Atlantic States to the Great Lakes and throughout the West. A third problem is 'variability,' or fluctuation in streamflow. Depletion, or man-made variability, intensifies the destructiveness of alternating drought and flood. Moss discusses the implications of national abuse for recreation and for wildlife. The second half of the book suggests the cure for the nation's ills. Moss gives examples of good regional planning. He recommends a national Conservation Job Corps. California, West Germany, and Orsanco provide examples of water reuse. Moss documents advances in research, particularly regarding desalination, weather modification, and water pumping. In his conclusion, Moss discusses capabilities of present governmental agencies, their histories, and recommendations of other reports. He recommends the establishment of river-basin authorities and creation of a Department of Natural Resources. He outlines a minimum water resources program. (Gossen-Chicago)
W69-05113

THE HYDROGEOLOGIST'S RESPONSIBILITY -- METROPOLITAN WATER RESOURCE PLANNING,
Department of Housing and Urban Development, Washington, D. C.
Arthur J. Zeizel.
Transactions American Geophysical Union, Vol 49, No 3, pp 543-547, September 1968. 5 p, 2 ref.

Descriptors: *Municipal water, *Hydrogeology, Water pollution sources, Waste disposal, Flood damage, Groundwater, Recreation facilities, Water utilization, Land reclamation Pollution abatement, Groundwater recharge, Flood control, Drainage, Engineering.
Identifiers: *Comprehensive planning, Chicago.

Using metropolitan Chicago as an example, this paper described emerging metropolitan water problems, discusses the procedures of comprehensive water resource planning, and examines the traditional and changing role of the hydrogeologist in water planning. Inadequate waste disposal practices in Chicago pollute streams, recreational lakes, parts of Lake Michigan, and the ground-water source of supply to metropolitan residents. Other intense metropolitan water problems include increasing flood losses, haphazard evaluation and development of ground-water sources, lack of adequate water-oriented recreational facilities, and inefficient water use. The comprehensive water resource planning approach evaluates the full range of available alternative water management measures. Its basic consideration is how changes made in one component of a water system will affect other components. A role of the hydrogeologist in water planning is to define the total water system before planning for management. Immediate demands on the hydrogeologist come from waste disposal, land reclamation, stream pollution reduction, ground-water recharge, flood loss reduction, drainage, engineering problems, and enhancement of the urban environment. Study teams of closely-working members who represent varied professional disciplines, including hydrogeology, can best determine legal, administrative, and technical feasibility of alternatives. (Gossen-Chicago)
W69-05114

WATER RESEARCH,
Resources for the Future, Inc., Washington, D. C.
Allen V. Kneese, and Stephen C. Smith.
Baltimore: Johns Hopkins Press, 1966. 526 p.

Descriptors: *Water management, *Theoretical analysis, *Engineering, *Political aspects, *Administration, Discount rate, Investment, Alternative costs, Water resources development, Water management, Recreation, Industrial water, Water quality, Flood control, Legislation, Water transfer, Flood damage, Efficiencies, Cost-benefit analysis, Synthetic hydrology, Rainfall, Runoff, Snow management, Management, Reservoirs, Analog models.
Identifiers: *Water Resources Act of 1964, *Evaluation problems, *Water reallocation, *Research programs, Potomac Estuary, Water recreational facilities, Delaware Estuary.

The pressure on supplies of usable fresh water in many parts of the country has led to an increasing amount of research on the problems of planning and managing our water resources. The Sixth Western Resources Conference at which the papers in this volume were initially presented was organized by Resources for the Future Inc, the University of Colorado, Colorado State University, and the Colorado School of Mines to give leading experts in the field the opportunity to report on and discuss their current research. In the Introduction, Dr. Kneese analyzes the major developments in water research in the past decade. The most recent of these developments if the Water Resources Act of 1964. The volume provides both a survey of past efforts and recommendations for future work. The twenty-six contributions are divided into seven parts: Issues in Theoretical Analysis, Case Studies of Water Management, Research on Evaluation Problems, Studies of Water Reallocation, Political and Administrative Studies, Research on Hydrology and Engineering and Major Research Programs and Needs. (Loeb-Rutgers)
W69-05115

PLANNING A WATER QUALITY MANAGEMENT SYSTEM: THE CASE OF THE POTOMAC ESTUARY,
Resources for the Future, Inc, Washington, D. C.
Robert K. Davis.
Water Research, pp 99-121, Johns Hopkins Press, Baltimore, 1966. 23 p, 4 fig, 4 tab, 13 ref.

Descriptors: *Water quality, *Planning, Cost analysis, Dissolved oxygen, Estuaries, Water pollution, River basin development, Cost-benefit analysis, Optimization, Input-output analysis, Biochemical demand, Low-flow augmentation, Efficiencies.
Identifiers: *Potomac River estuary, Dissolved oxygen management, Cost function, Multipurpose system, Alternative system, Least cost.

This is a study of the cost of alternative systems for dissolved oxygen management in the Potomac River estuary. The technological functions developed in this study are believed comparable in reliability to the cost functions used by the Corps of Engineers. Nevertheless, because of the experimental nature of some of the processes analyzed, the results reported can't be viewed as a technical revision of the Engineer's proposal for the Potomac, but rather as a consequence of some strategic modifications in the water resource planning process. The paper demonstrates the nature of the gains to be realized from expanding the analysis of alternatives in the water resources planning process. Some productive dimensions of an expanded analysis are: (1) to extend the analysis to more than one kind of objective and to more than one set of objectives so that we can begin to

ask some questions about willingness to pay for results, (2) to extend the analysis to payoffs from possible changes in technology and (3) to extend the analysis to possibilities which may be precluded by current institutional arrangements, in order to know something of the gains derived from rearranging institutions bearing on the design and operation of water quality management systems. (Loeb-Rutgers)
W69-05116

WATER TRANSFER PROBLEMS: LAW,
New Mexico Univ., Albuquerque.
Willis H. Ellis.
Water Research, pp 233-248, Johns Hopkins Press, Baltimore, 1966. 16 p, 6 fig, 9 ref, 1 append.

Descriptors: *Water transfer, *Water rights, *Legislation, Income, Population, Industrial use, Water allocation.
Identifiers: Growth potential, Standard of living, Agricultural use, Abandonment, Forfeitures, Downstream transfers, Upstream transfers.

In the western United States, water may be a limiting factor of production and thus limit the growth potential of the region as to the number of people within the region and their standard of living. Two things a community can do when its growth is threatened by a limited supply of water are: (1) find new sources of supply or (2) utilize its limited supply more efficiently. This paper considers the possibilities inherent in the second alternative and concludes that at the present time the water-right market is inefficient because those who would enter it must expend considerable amounts of money just to do so. The paper attempts to show that a state could pay these costs in advance so that potential buyers could enter the water-right market and pay (in the vast majority of cases) only the agreed price for the right purchased. The benefit to the state in greater economic return from its available supply of water should be great. (Loeb-Rutgers)
W69-05117

OPTIMAL FLOOD DAMAGE MANAGEMENT: RETROSPECT AND PROSPECT,
Resources for the Future, Inc., Washington, D. C.; Chicago Univ., Ill.
Gilbert F. White.
Water Research, pp 251-269, Johns Hopkins Press, Baltimore, 1966. 19 p, 1 tab, 29 ref.

Descriptors: *Management, Flood control, Flood damage, Water resources, Flood protection, Flood plains, Technology, Flood plain insurance.
Identifiers: Optimal method, Optimal management, Public policy, Denver flood, Resources management, Choice.

The author reviews the experience with management of flood losses in several steps. In beginning, a confession is made for the confusion concerning optimal management. Next, the state of knowledge about the human use of flood plains is summarized. Those findings that seem sufficiently valid to warrant recommendation for public policy are pointed out. Major research needs are outlined by pointing to those areas where there is a lack of knowledge. Both knowledge and ignorance are stated more concretely in reference to the Denver flood of June 1965. Finally, the concluding section states that what we have learned may be of value in other sectors of resources management. (Loeb-Rutgers)
W69-05118

POLICY PROBLEMS IN THE FIELD OF WATER RESOURCES,
Resources for the Future, Inc., Washington, D. C.
Irving K. Fox.
Water Research, pp 271-289, Johns Hopkins Press, Baltimore, 1966. 19 p, 7 ref.

Descriptors: *Water resources, *Water policy, Decision making, Water utilization, Attitudes, Water resources development, Benefits, Water quality.
Identifiers: Opportunities, Social optimum, Public decision making, Water abundance, Water disposal, Public policy, Public policy change.

Water resources policy issues have been studied intensively and reported on frequently since the end of World War II. In this paper, it is proposed to examine several overriding problems which promise to be of major, if not dominant, significance in the conduct of water resources activities in the next few decades. The over-all environment within which policies evolve and programs are undertaken will have much to do with the future course of events in the water field. In our concentration on the technical aspects of water uses, we may fail to see the restraints of what is feasible that are imposed by our cultural and institutional environment. The three problems to be considered are: (1) how to achieve a rational public understanding of water resource use problems and opportunities; (2) how to achieve a reasonable approximation of a social optimum through public decision-making process, and (3) how to change policy to accord with the changing environment within which water resources activities are undertaken. (Loeb-Rutgers)
W69-05119

THE IMPACTS OF WATER INVESTMENTS IN DEPRESSED AREAS,
Resources for the Future, Inc., Washington, D. C.; North Carolina State Univ., Raleigh.
G. S. Tolley.
Water Research, pp 457-470, Johns Hopkins Press, Baltimore, 1966. 14 p, 1 fig, 2 tab, 2 ref.

Descriptors: Labor supply, Migration, Employment, Aggregates, Water resources development, Recreation, Low-flow augmentation, Income, Cost-benefit analysis.
Identifiers: *Water investment, *Depressed areas, Appalachian Act, Public investment, Secondary benefits, Multiplier.

This paper has concentrated on some needs for evaluating water resource development proposals for depressed areas. It has not exhausted the list of needs for greater understanding to which the research at North Carolina is directed. Recreation is an increasingly important purpose of projects, particularly in depressed areas. While much progress has been made in recent years in estimating recreation benefits, methods are still lacking to estimate adequately the value of recreation quality and competition between sites. V. S. Hastings and S. Sydneysmith are conducting studies on these subjects. Provision of water for low-flow augmentation affects water available to industry as an intake and as a medium of waste disposal. The recognition of regional development as a project aim, in addition to national income aims, increases the need to understand effects of water availability on industry location. (Loeb-Rutgers)
W69-05120

ECONOMICS AND FINANCE OF WATER DEVELOPMENT IN ALBERTA, CANADA,
G. R. Purnell.
Int. Conf. on Water for Peace, Wash., U. S. Gov't. Printing Office, Vol 8, pp 747-754, 1968. 8 p, 1 map, 6 ref. For 8 volume Proceedings see Vol 2, No 9, Field 06B, W69-03305.

Descriptors: *Administration, *Cost-benefit analysis, *Feasibility, Design, Operation and maintenance, Water resources development.
Identifiers: *Province of Alberta.

Basic to the development and operation of water projects is financing and administration. The administration of the project must be closely related to its financing. Those who benefit the most from the project and those who contribute funds to the development and operation of the project will have the greatest interest in its administration. In 1965 an historical analysis of the financing and administration of water development projects in the Province of Alberta was begun. Historically, financing had been provided by heterogeneous sources and the administration was also varied. Under the auspices of a policy advisory committee, a series of engineering and economic studies were undertaken. These studies were made within a benefit-cost framework. The policy recommendations based on the studies include: consolidation of all legislation into one statute and code; and the establishment of uniform locally based administrations related to water system boundaries. (Grossman-Rutgers)
W69-05122

ECONOMICS IN REGIONAL WATER RESEARCH AND POLICY,
Oregon State Univ., Corvallis. Dept. of Agricultural Economics.
Emery N. Castle, and Russell C. Youmans.
American Journal of Agricultural Economics, Vol 50, pp 1655-1666, Dec 1968. 12 p, 1 fig, 19 ref.

Descriptors: *Federal Government, *Investment, Cost-benefit analysis.
Identifiers: *Hirschman Development Theory, Regional economics.

This paper is in two parts. Part I pertains to water resources and regional economic growth. Part II discusses choice indicators in public decision making with respect to investment in natural resource investment. Recent federal action and statements are discussed, then research results on water availability and economic growth are examined. Using the Hirschman development theory, the author analyzes some growth hypotheses. In the section on choice indicaters in public decision making, the following are mentioned: benefit-cost analysis, economic efficiency, ultimate goals of any society, and individual fulfillment. A reference list is included in the report. (Grossman-Rutgers)
W69-05124

THE NATIONAL WATER RESOURCE ASSESSMENT AND REGIONAL FRAMEWORK PLANS,
Water Resources Council, Washington, D. C.
Harry A. Steele.
American Journal of Agricultural Economics, Vol 50, No 5, pp 1647-1654, Dec 1968. 8 p, 6 ref.

Descriptors: *Water Resources Planning Act, *Legislation, Governments.
Identifiers: *Water Resources Council, National Water Commission.

The paper reviews progress of water resource plans under the Water Resources Planning Act (Pl 89-80) and outlines some of the problems encountered. First, there is an explanation of the Water Resources Council, a cabinet-level group interested in water and related land resources. The paper then discusses the Council's national assessment of the adequacy of the nation's water resources to meet requirements. The Council also set up a framework for future development and management of water and related land resources of a region. The framework includes: projections of economic growth, translations of projections into requirements for water and related land resource uses, projections of the availability of water resources, projections of land resource availability, analysis of alternative solutions, and recommendations of needed detailed planning, program authorizations, and other actions. Under the Act, river basin commissions, in addition to their other functions, are to recommend long-range schedules of priorities for the collection and analysis of data. Also discussed in this paper is the impact of urban growth, planning policies and standards, and the establishment of the National Water Commission. (Grossman-Rutgers)
W69-05125

AN EFFICIENT PROGRAM OF WATER RESOURCE DEVELOPMENT IN A FRAMEWORK OF GROWTH AND TRADE,
Hebrew Univ., Jerusalem (Israel); Resources for the Future, Inc., Washington, D. C.
Pinhas Zusman, and Irving Hoch.
American Journal of Agricultural Economics, Vol 50, No 5, pp 1635-1646, Dec 1968. 12 p, 1 fig, 1 tab, 15 ref.

Descriptors: *Leontief models, *Cost-benefit analysis, *Water resources development, Investment.
Identifiers: *General equilibrium model, California.

Decisions concerning investment programs in water systems must be taken with reference to the general capital formation process, anticipated technological charges, population growth, demand behavior, present and future trade opportunities, interregional resource movements, and expected changes in the industrial composition of output and income. The problem of water resources development is approached via a general equilibrium analysis which considers all sectors of the economy simultaneously. The state's economy is represented by a Leontief-type model. The model is developed and discussed. The results are presented and evaluated. A reference list is included. (Grossman-Rutgers)
W69-05127

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

COST PROJECTIONS FOR LARGE DESALTING SYSTEMS WITH VARIOUS TYPES OF COUPLING,
For primary bibliographic entry see Field 03A.
W69-04814

RURAL COMMUNITY WATER SUPPLIES, A DISCUSSION IN FINANCING,
Mark D. Hollis.
For 8 Volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 8, pp 729-36, 1968. Washington, D C: U S Government Printing Office, 8 p, 1 tab.

Descriptors: Financing, Water supply.
Identifiers: Latin America, Rural Water Program, Revolving fund, International loan, Funding mechanism, Alliance-for-Progress Decade.

The shape of the future rural habitat in Latin America can no more be left to chance then can the urban habitat. This document discusses the background and progress toward the rural water supply goals established in the Charter of Punta del Este. It points out the need for a more concerted effort in the Rural Water Program, and it proposes a funding mechanism to support a system of national revolving funds. These funds will be used, first, for loans to qualifying communities to construct water systems and, subsequently (after becoming self-sustaining) for related community improvements. The rural water proposal has three key objectives: first, to provide impetus to the program and accelerate construction over the second half of the Alliance Decade; second, to strengthen community organization and to develop more fully the self-help potential; and, third, to establish, in each country, a self-sustaining funding mechanism. (Loeb-Rutgers)
W69-04820

FINANCIAL ASPECTS OF POTABLE WATER AND SEWERAGE SYSTEMS,
For primary bibliographic entry see Field 05D.
W69-04821

WATER SYSTEMS FINANCING--FOUR BASIC APPROACHES,
Floyd B. Taylor, and Paul W. Hughes.
For 8 Volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 8, pp 758-762, 1968. Washington, D C: U S Government Printing Office, 5 p.

Descriptors: Water supply, *Financing, Payment, Training.
Identifiers: *Water systems financing, Paternal financing, Self-help financing, Revolving fund financing, Bond issues, Paja de agua.

Experience, on a world-wide basis, indicates four basic methods in the financing of urban water supply systems. The type of financing in any given country is generally indicative of the degree of economic and political development. The four basic approaches to community water supply financing are (a) paternal, (b) self-help, (c) revolving fund, and (d) bond issue. The authors discuss in detail the four basic approaches to the financing of water supply systems and review the relative merits of each. (Loeb-Rutgers)
W69-04824

ANALYSIS OF THE COST OF WATER TRANSMISSION BY PIPELINE,
For primary bibliographic entry see Field 03A.
W69-04827

ROAD PRICING, SOME TECHNICAL ASPECTS,
Birmingham Univ. (England)
A. A. Waters.
Economist, Vol 116, No 6, pp 716-728, Nov/Dec 1968. 13 p, 2 fig, 4 ref.

Descriptors: *Pricing, Dynamics, Demand, Fluid mechanics, Velocity, Marginal costs.
Identifiers: *Road user charges, *Balanced road budget, *Social costs, Traffic flow, Congestion.

Under conditions of congestion, the social costs of motoring will exceed the private costs. The formula is: Social Cost = Private Cost (1 + the elasticity of cost with respect to traffic flow). Thus the optimumtax under these conditions is equal to this elasticity coefficient multiplied by 100 percent of the private cost. A fluid-dynamic model, borrowed from physics, is used to develop a simple formula for the elasticity of velocity with respect to traffic flow. By postulating a relationship between cost and speed, this elasticity is converted into an estimate of the elasticity coefficient. And so one can obtain, for any specified speed, a value of this coefficient and cost; the product of these two gives an estimate of the difference between social and private cost. In practice one cannot determine the speed independently; it emerges from the demand-supply interactions and so one must also postulate a demand function, but data problems are severe on the demand side. Lastly, some developments are considered--including network models and dynamic demand models. This analysis is also applicable to the use of prices to avoid congestion on waterway facilities, and to water supply problems involving the use of pipe transmission methods. (Sokoloff-Rutgers)
W69-04837

CONGESTION, TOLLS, AND THE ECONOMIC CAPACITY OF A WATERWAY,
Carnegie-Mellon Univ, Pittsburgh, Pa., Rand Corp., Santa Monica, Calif.
Lester B. Lave, and Joseph S. De Salvo.
Jour Pol Econ, Vol 76, No 3, pp 375-391, May 1 June 1968. 17 p, 3 fig, 3 tab, 7 ref.

Descriptors: *Locks, *Taxes, Efficiencies, Cost-benefit analysis.
Identifiers: *Illinois Waterway, *Externality, *Queuing time, *Social cost, *Congestion, Tolls, Tows, Subsidies, Economic capacity.

The analysis of congestion becomes complicated when the arrival of customers is random or the service rate is random. In this stochastic case, optimal economic capacity will be far less than physical capacity. When a facility is used by a number of independent customers, there is an externally associated with the decision to use the facility. Social cost is far greater than private cost in the absence of a tax system or regulatory scheme. Three questions arise whenever congestion occurs: (1) the optimal use of a facility-which might be answered by a system of optimal tolls or subsidies which equate private to social cost. The second question concerns the decision to expand physical capacity. This might be answered by a benefit-cost analysis of the expansion decision, if the dollar benefit exceeds the cost of expansion, physical capacity should be increased. The third question concerns the effect of a toll on the character of the service demanded (the amount of service demanded) (the amount of service time demanded). Since there is an ability to change tow size (and thereby service time), the optimal toll on a waterway should be calculated on the basis of actual service time. This article treats some thorny economic problems involved in water resources, capacity, pricing, and investment timing, and the issues raised are readily extended to problems in water projects other than those of waterways. (Sokoloff-Rutgers)
W69-04838

THE ECONOMIES OF SCALE,
Chicago Univ., Ill.
George J. Stigler.
Journal of Law and Economics, Vol 1, pp 54-71, Oct 1958, 18 p, 1 fig, 8 tab.

Descriptors: *Economies of scale, Regression analysis, Technology, Marginal costs, Average costs.
Identifiers: *Survivor technique, *Optimum size, *Empirical studies, Industry capacity, Actual costs, Rates of return, Steel industry, Auto industry, Petroleum industry.

The survivor technique for determining the range of optimum sizes of a firm seems well adapted to left the theory of economies of scale to a high level of substantive content. Although it is based on inadequate information, the determination of optimum sizes avoids the enormously difficult problem of valuing resources, which occurs with alternative methods. The most striking finding is customarily a fairly wide range of optimum sizes--the long run marginal and average cost curves of the firm are customarily horizontal over a long range of sizes. The survivor method can be used to test the numerous hypotheses on the factors determining the size of firm. The study suggests that advertising expenditures have no general tendency to lead large firms. Size of plant proves to be an important variable and the survivor method should be employed to determine the factors governing plant size. An index of chemistry and engineers as a ratio to all employees was used as a measure of technological characteristics and research and proved to be fairly important. Optimum plant scale is also an important issue in water development and this article can be used in applying the economic issues of optimum plant size of private firms to water producing plants and utilities. (Sokoloff-Rutgers)
W69-04840

DIRECT VERSUS INDIRECT TAXATION,
Trinity Coll., Oxford (England).
I. M. D. Little.
Econ Jour, Vol 61, No 3, pp 577-584, Sept 1951. 8 p, 3 fig.

Descriptors: *Labor supply, Prices.
Identifiers: *Income tax, *Indirect tax, *Transformation curve, *Leisure, Pareto optimum, Incentives, Revenue, Marginal conditions.

The first part of the article is designed to show that the usual theoretical treatment of the problem of direct and indirect taxation is based on extraordinary assumptions, and liable to be misleading. An alternative mode of analysis is suggested, which in-

cludes marginal rates of transformation as well as marginal rates of substitution. It is shown that no case against indirect taxation can be proved from the ordinary, general, purely competitive assumptions of economic theory (pareto efficiency); and that the special assumption necessary to prove such a case, a constant supply of labor involves an unplausible conclusion concerning incentives. The general conclusion is that the best taxes (subsidies) are those on goods for which the demand is least elastic. Income tax, which is a subsidy or leisure is no exception; only so far as the demand for leisure is highly inelastic is it a good tax. This would apply to the pricing and/or taxation policy for water resources. (Sokoloff-Rutgers)
W69-04848

THE PROBLEM OF SOCIAL COST,
Virginia Univ., Charlottesville.
R. H. Coase.
Journal of Law and Economics, Vol III, pp 1-44, Oct, 1960. 44 p.

Descriptors: *Welfare, *Resource allocation, Alternative costs, Administrative costs, Taxes.
Identifiers: *Social product, *Private product, Pigou, Price system, Liability damages, Case studies, Harmful effects.

Analysis in terms of divergencies between private and social products concentrates attention on particular deficiencies in the system and tends to nourish the belief that any measure which removes the deficiency is necessarily desirable. Attention is diverted from those other changes in the system which are inevitably associated with the corrective measure, changes which may well produce more harm than the original deficiency. It would seem more desirable to compare total product yielded by alternative social arrangements, and to take into account the total effect of these arrangements in all spheres of life. Also instead of a comparison between a state of laissez-faire and some kind of ideal world, a better approach would be to start with a situation approximating what actually exists, and then examine the effects of a proposed policy change and decide whether the new situation would be, in total better or worse than the original one. It is also pointed out that if factors of production are thought of as rights, it becomes easier to understand that the right to do something which has a harmful effect is also a factor of production. This type of approach could be used in an analysis of the effects of water pollution. (Sokoloff-Rutgers)
W69-04850

INFLATION AND INCOME DISTRIBUTION (GERMAN),
Hamburg Univ. (West Germany).
Harald Scherf.
Weltwirtschaft Archiv, Vol 100, No 2, pp 258-271, June 1968. 13 p.

Descriptors: *Inflation, Monopoly, Profit.
Identifiers: Demand pull, *Income distribution, Entrepreneurs, Oligopoly, Price fixing, Monetary interpretation, Regressive, Real wealth.

Since Mitchell's study 'History of the Greenbacks' and Bresciani--Turronis's analysis of the German Inflation after World War I, it is the generally accepted view that inflation redistributes income and wealth regressively. Recent investigations of the problem do not support this doctrine. In a critical analysis of these investigations the author concludes that there is no proof of a redistribution of income and wealth in favor of entrepreneurs against the working population by slow inflation. Social difficulties arise only in the adaption of income of retired people to rising prices. The problems of inflation and income distribution indirectly effect the water resource area through their influence on investment incentives, savings effects, and government anti-cyclical policies, all of which in turn may effect water investment and development programs. (Sokoloff-Rutgers)
W69-04851

SOME NEIGHBORHOOD EFFECTS OF OIL-SHALE DEVELOPMENT,
Utah State Univ., Logan.
B. Delworth Gardner, and Allen D. Lebaron.
Natural Resources Journal, Vol 8, No 4, pp 569-586, Oct 1968. 18 p.

Descriptors: *Oil shale, *Water requirements, *Water pollution, *Colorado River Basin, Agriculture, Mexican Water Treaty, Technology, Wyoming, Utah, Radioactivity.
Identifiers: *Neighborhood effects, Refining operations, Transferability, White River.

Few of the issues connected with oil-shale development have been as controversial as those surrounding water requirements. Opinions run the gamut from belief that water supplies are quite adequate to the notion that water shortages will constrain the size of the industry. Water could be allocated like any other marketed commodity and would be price-rationed to the highest bidder. The economic impact on the local economy, especially the agricultural sector, will be determined largely by transfer flexibility and whether new water supplies become available. If farmers are free to sell water or continue to hold and use it, then sale of water should provide ample compensation and minimize neighborhood effects. If it is assumed that technology and water prices are such that the industry will demand approximately 250,000 acre-feet of water per year, what are the prospects for obtaining this quantity of water. These possibilities are either to file for rights on newly-developed water or purchase rights from present users of already appropriated water. The difficulty with the first alternative is that interstate compacts and an international treaty with Mexico greatly limit the amount of water available. Therefore, additional irrigation rights will have to be purchased from agricultural users, but these are marginal producers in the oil-shale region. (Sokoloff-Rutgers)
W69-04854

THE ANATOMY OF MARKET FAILURE,
Massachusetts Inst. of Tech., Cambridge.
Francis M. Bator.
Quart Jour Econ, Vol LXXII, No 3, pp 351-379, August 1958. 29 p.

Descriptors: *Welfare.
Identifiers: *External economies, *Pareto efficiency, Public goods, Social welfare function, Income distribution, Convexity, Competitive markets.

The Paretian maximization-of-welfare problem has embedded within it a set of constants, 'duals' or shadow prices, which have all the analytical characteristics of prices, wages, rents, and interest rates. Implied in this analysis is the notion that decentralized market calculations correctly account for all 'economic' costs and benefits. Duality can fail in 5 ways: by existence--no set of relative market prices will accurately reflect the maximization of a welfare function by being equated to a set of marginal rates of substitution; by signal--the price system guides profit-maximizing entrepreneurs into a position of profit minimum or local profit maximums rather than the maximum maximorum; by incentive--the price system allows negative profits in some desired industries; by structure--if self-policing perfect competition is not present, then prices do not lead to Pareto optimality; and by enforcement--if there is some arbitrary legal or organizational imperfection in the market which prevents introduction of proper accounting prices for inputs or outputs into maximization decisions. These five modes are due to three possible causes of market failure: ownership externalities, technical externalities, and public goods externalities. Economic discussions of water often invoke the technical, ownership and public goods externalities in the analysis of pricing and valuing of water uses. This article presents a comprehensive classification scheme for markets, that like the water market, require public intervention in their functioning. (Sokoloff-Rutgers)
W69-04855

PRODUCERS' MARGINS FOR FOOD FISH AND SHELLFISH,
David K. Saback.
Bureau of Commercial Fisheries, Circular 156, November, 1962.

Descriptors: *Commercial fishing, *Commercial shellfish, *Marketing, *Gross profit, *Indirect costs, Fish harvest, Profit, Net profit, Appreciation, Market value, Economics, Competitive prices, Fishing, Industries, Fisheries, Animals, Aquatic animals, Aquatic life, Invertebrates, Shellfish, Value, Costs, Prices.

This article discusses the principal factors affecting producers' (fishermen) margins, defined as the portion he receives of the retail price paid by the consumer and expressed in this report as a percentage of the retail price. The author discusses trends in these margins from around 1947 through 1960. Although the percentages vary, the trends are quite significant. The total amount of fisheries products and the various steps undergone by the product, e.g. costs of packaging plants and equipment, storage facilities, and transportation are discussed as factors affecting producers' margins. Also discussed are factors affecting the producers' margins for specific fisheries products. Tables and graphs are included which show trends in margins for particular species.
W69-05053

THE VALUE OF A TON OF GENERAL CARGO TO THE AREA'S ECONOMY--DELAWARE RIVER PORT.
Report, Division of Port Development, Delaware River Port Authority, Camden, New Jersey, 1962.

Descriptors: *Harbors, *Delaware River, *Economic impact, *Inflation (Economic), Income, Value, Bodies of water, Interstate rivers, Rivers, Running waters, Streams, Surface waters.

This is a revision of the original study of the same title which was issued in 1953. The revision has been limited to updating the value of a ton of general cargo over the period between 1950 and 1962 from $11.33 to $16.22.
W69-05061

GROUNDWATER UTILIZATION AND TAX POLICY,
Texas Technological Coll., Lubbock. Dept. of Agricultural Economics.
Herbert W. Grubb.
American Journal of Agricultural Economics, Vol 50, No 5, pp 1621-1630, December 1968, 10 p, 1 fig, 6 ref.

Descriptors: *Groundwater, *Taxes, *Prices, *Costs, Aquifers, Irrigation.
Identifiers: *Tax policies, Stock resource, Flow resource.

The purpose of this paper is to discuss major issues regarding effects of taxation upon the use and ultimate value of groundwater as a capital resource. The discussion will be centered around property taxes. Some sources of groundwater could be considered as stock resources and other sources could be considered flow resources. These different types of water deposits present different questions with regard to groundwater resource use and tax policy. The flow resource should be used to the extent that marginal cost equals marginal revenue, measured annually. The stock resource, such as water in a nonrecharging aquifer, is available for use at a later production period and presents conservation questions about intertemporal allocation, given irrigation production and costs. Tax policies should be governed by the major goals and objectives of the groundwater resource utilization. The present approach to taxing groundwater is discussed, as are the needed policy measures. References are included in the report. (Grossman-Rutgers)
W69-05126

AN ECONOMIC ANALYSIS OF WATER UTILIZATION IN PENNSYLVANIA,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
For primary bibliographic entry see Field 06D.
W69-05154

6D. Water Demand

WATER SUPPLY SCHEME OF GREATER TEHRAN CITY,
Tehran Regional Water Authority, (Iran).
A. Dilmaghani.
For the 8 Volume Proceedings, see Vol 2, No 9, Field 06B W69-03305. Int Conf on Water for Peace, Wash D C, Vol 6, pp 826-836, 1968. 11 p.

Descriptors: *Municipal water, *Water sources, Rivers, Groundwater, Water treatment, Water resources development, Urbanization, Water consumption (Excludes consumptive use).
Identifiers: *Tehran (Iran).

Tehran City lies approximately on latitude 36 deg N. at an average altitude of 1200 m above sea level. The total area of the city is about 250 sq km, of which roughly 150 sq km is constructed at the present time. Population of the greater city is estimated to be 2.5 million. The ultimate population in 15 years is assumed to be 4 million. The first stage design of the water-supply scheme started in 1946. At that time the system was designed for 1,400,000 inhabitants of the central city but a preliminary stage for 900,000 population was built. However, the expansion of the city and increase of population took place much earlier than it was expected. The gap between 900,000 and 1,400,000 inhabitants was filled in 5 yr instead of 30 yr. In 1959 it became quite necessary to draw up a long term program to supply water for greater Tehran, with a population of 4,000,000 and water consumption of 400 million cu m per yr. The new program was forseen to cope with water requirements of the city for the next 20 yr. In designing the scheme, 250 litres per capita per day was considered the average. Tehran's water sources are the Karaj River (40 km west of city), the Jajirud River (30 km east), the Lar River (70 km NE), and groundwater. (Knapp-USGS)
W69-04761

ECONOMICS AND FINANCE OF WATER PROGRAMMES: ECONOMIC ANALYSIS, FINANCIAL ANALYSIS, FINANCING.
World Health Organization, Geneva (Switzerland).

For 8 Volume Proceedings see Vol 2, No 9, Field 06B, W69-03305. International Conference on Water for Peace, Vol 8, pp 708-710, Washington, D C, U S Government Printing Office, 1968. 3 p.

Descriptors: *Water supply, *Financing, Pricing, Investment, Capital supply, Benefits, Loans, Grants, Public utilities.
Identifiers: *Construction funds, Shortages, Revenue, Secondary benefits, Government support.

It has been shown that capital can be invested profitably in water supply if provision for adequate management and safeguarding the asset has been made. But for the purpose of project formulation it is sometimes difficult to demonstrate indirect benefits which may accrue from water supply systems whereas direct benefits can easily be calculated when looking at water as a commodity which is sold to the water users at a certain price. A still more quantitative evaluation of the direct benefits of community water supplies will be possible on the basis of current research into the nature of the demand curve of public water supplies, which would allow estimation of the consumer surplus. The financing of water supply is a problem located somewhere between a rigid business approach and the subsidizing of a social welfare project. WHO--assisted projects for the planning of community water supply systems in developing countries include the economic and financial analysis as a routine procedure and two noteworthy examples (water supply systems of Seoul, Korea and Accro-Tema, Ghana) are described in some detail in the paper. (Sokoloff-Rutgers)
W69-04833

OUTDOOR RECREATION DEMANDS AND BENEFITS,
Jack L. Knetsch.
Land Economics, Vol 39, No 4, 1963, pp 387-396.

Descriptors: *Recreation demand, *Mathematical analysis, *Investment, *Public benefits, *Value, Recreation, Economic impact, Benefits, Demand, Analysis, Land, Property values, Shores.

The author uses a hypothetical example to demonstrate the construction of demand curves for recreation sites. The analysis is extended to include the effects of time of travel and the availability of close substitutes. Total recreation value is broken into two sources. The first source represents user benefits which people receive from visits to the area. The second source is the capital investment in land near the recreation site. (Land value benefits could be substantial in the case of private recreation facilities along estuarine shorelines). Effects of fee collection are also incorporated into the analysis.
W69-05014

WATER RESOURCES ACTIVITIES IN THE UNITED STATES: WATER SUPPLY AND DEMAND.
Report, Select Committee on National Water Resources, United States Senate, 86th Congress, Committee Print No. 32, August, 1960.

Descriptors: *Water supply, *Water demand, *United States, *Regional analysis, *Forecasting, Water resources development, Geographical regions, Regions, Demand, Supply.

This is a report on the nation's prospective supply of and demand for water in 1980 and 2000. The overall results are summarized and tabulated for the entire country by water resources regions.
W69-05065

WATER USE IN MANUFACTURING, 1963 CENSUS OF MANUFACTURES.
Report, Bureau of the Census, Department of Commerce, 1963.

Descriptors: *Water utilization, *Geographical regions, *Industrial plants, Efficiencies, Buildings, Engineering structures, Structures, Regions, Industrial water, Water types.

This is a report of the 1963 Census of Manufactures data. Water-use data are cited for 2-, 3-, and 4-digit SIC industries by geographical regions and by specific use category.
W69-05066

DEMAND FOR WATER RECREATION,
Virginia Polytechnic Inst., Blacksburg.
Norman L. Brown, and Donald C. Darnton.
Project Completion report, 4 fig, 16 p, August 1968, OWRR Project A-016-Va, 14-01-001-1415.

Descriptors: *Recreation demand, Recreation, Demand, Water sports, Recreation facilities, Methodology.
Identifiers: Roanoke.

The project was designed as a pilot project aimed at developing a method for estimating the value placed on certain types of water recreation activities. The pilot project had four objectives: (1) to develop the questionnaire for collecting information, (2) to determine the best way to distribute and collect the questionnaire, (3) to determine specific recreation sites to be included in the major study, (4) to obtain the cooperation of the owners of the selected study sites. The objectives were later revised to include the analysis of the information obtained as the questionnaire was being tested. The first goal was only partially achieved and the researchers encountered the conceptual problem of determining exactly what is being measured when a user engages in two or more water activities on a single outing. Until this problem is solved, the final form of the questionnaire cannot be prepared. The other project goals were more fully obtained. (Winn-Rutgers)
W69-05121

AN ECONOMIC ANALYSIS OF WATER UTILIZATION IN PENNSYLVANIA,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
J. Dean Jansma, and Waldon R. Kerns.
Institute for Research on Land and Water Resources, Research Publication No. 54, University Park, Pa., June 1968. 75 pp, 6 fig, 21 tab, 1 append. 14-01-0001-983. OWRR Project A-007-PA.

Descriptors: *Water demand, *Regressional analysis, *Water values, *Water users, *Water rates, Economies of scale, Industrial water, Pricing, Pennsylvania, Water requirements, Water utilization.
Identifiers: Economic analysis.

This study outlines the current pattern of water use at the county level for the industrial, residential, commercial, and public sectors, and analyzes price-quantity relationships for water used in Pennsylvania. The utilization patterns were based on a 'per employee requirement' allocation technique. The basic relationships developed were water intake, average price per thousand gallons, and total water expenditures. The data indicated wide variations in the average price paid per thousand gallons of water. The range was from $1.73 per thousand gallons to less than $.06 per thousand gallons. Linear, quadratic and logarithmic regression equations were estimated and tested for significance to determine price-quantity relationships. The regression equations indicated that the logarithmic form produced the 'best fit' between price of water and quantities purchased. The utilities owned by municipalities had the lowest average cost per gallon; privately owned utilities were generally the highest in terms of water prices. (Sink-Penn State)
W69-05154

6E. Water Law and Institutions

WATER POWER LINKS RIPARIANS - AUSTRIA CONTRIBUTES TO INTERNATIONAL COOPERATION,
Oesterreichische Elektrizitaetswirtschafts A.G., Vienna.
Rudolf Parth.
For the 8 Volume Proceedings, see Vol 2, No 9, Field 06B W69-03305. Int Conf on Water for Peace, Wash D C, Vol 5, pp 62-67, 1968. 6 p.

Descriptors: *International law, *International waters, *Water resources development, Hydroelectric power, Rivers, International commissions, Governments, Riparian rights, Legal aspects, Treaties, Networks.
Identifiers: Austria, Germany, Yugoslavia, International river developments, Danube River, Inn River.

The Danube and its tributary, the Inn river form a part of the boundary between Austria and Germany. In the early fifties 2 agreements were established between the governments of Austria on the one hand and of the German Federal Republic and the Free State of Bavaria on the other hand, in order to harness the water power potential of this region in a cordial way and to the equal benefit of both riparians. Both provide for the organization of a joint stock company, whose shares are equally placed in the 2 countries. The Osterreichische Elektrizitatswirtschafts AG - Verbundgesellschaft (Austrian Grid Corporation) holds the Austrian

shares in trust for the State Authority. The German shares are held by State Authorities and state-owned power companies. The agreements contain regulations as to the organization and the action of the companies' management. Stress is laid on the principle of equal partnership concerning the ownership of the plants as well as personnel, investments, costs and power output. The power stations have no influence on the boundary treaties, both riparians regard them as inland plants. The international powerplant agreements follow the principle that the design should be made as if no frontier exists on the spot. In fact, frontiers do not prevent a free exchange of power and cordial water use for power production in other places of Austria too. The power export scheme in the utmost west of this country, the well-known Vorarlberger Illwerke, did not stop the power deliveries into the German grid system even in the post-war time 1945-46, when nearly all other communications between the two countries were interupted for many months, and when the former German shares of this company were annulled. The cooperation of powerplants situated on both sides of the frontier on the Drava River was the aim of an agreement between Austria and Yugoslavia. A joint commission is settling the problems of this frontier-crossing river in a manner which overcome difficulties of the lack of international water law. (Knapp-USGS)
W69-04777

MANPOWER PROBLEMS IN WATER SUPPLY ORGANIZATION,
Marseilles Water Co. (France).
M. Feline.
For the 8 Volume Proceedings, see Vol 2, No 9, Field 06B, W69-03305. Int Conf on Water for Peace, Wash, D C, Vol 5, pp 923-930, 1968. 8 p.

Descriptors: *Manpower, *Administrative agencies, *Employee relations, *Wages, Labor unions, Personnel, Organizations, Operation and maintenance.
Identifiers: *Water-supply companies.

A detailed analysis of personnel problems which may arise in water-supply companies shows that the problems of personnel are closely tied to operating structures, and the solution of these problems depends upon the choice made regarding such structures. Management methods, the organization of operating companies, the definition of relationships between such companies and the municipalities or the State, and the search for a financial policy regarding both operation and investment -- all these must be carefully studied. In order to obtain personnel stability a list of job descriptions should be drawn up, containing a number of well-defined levels allowing both for flexibility in the use of personnel and for improvement in average income. Water-supply companies, taking into account the comparisons with other branches of the private sector, are led to reassess the problem of salaries and benefits, and to establish an incentive formula or a production-bonus system. The State, and local communities and private companies have important roles to play in the water-supply field, but the State must clarify its policy and set limits on its participation, while specifying the conditions under which the water-supply companies may operate. Communities should re-examine their problems, and above all relinquish local prerogatives that are completely outmoded. Private companies should reconsider their methods, and see the supplying of water not as a mere source of profit, but rather as an opportunity to demonstrate that they can support a humane solution to the problems of the company, and institute a new personnel policy. (Vorhis-USGS)
W69-04779

MARINE RESOURCES AND THE FREEDOM OF THE SEAS,
Resources for the Future, Inc., Washington, D. C.
Francis T. Christy, Jr.
Natural Resources Journal, Vol 8, No 3, pp 424-433, July 1968. 10 p.

Descriptors: *International law, Legal aspects, *Law of the sea, International waters, Resources, Water resources, Economic efficiency.
Identifiers: *Freedom of the sea, Freedom of access.

The principle of the freedom of the seas has been maintained for a long time. As long as the use of the seas and its resources by one did not significantly decrease the use by another, there was no reason to separate the right of access from a right to a share in the wealth. But for many resources and uses of marine environment, this basic condition of abundance has passed. To maintain free access in view of this change is to persist in the waste and inefficient use of the seas. Access must be closed, and there must be provisions under which a user can acquire a right to exclude others from participating directly in the same use. But the association of access with a share of wealth makes such controls difficult and leads inevitably to conflict. A redefinition of the freedom of the seas, which disassociates the right of access from the right to the sea's wealth, may resolve this dilemma. (Winn-Rutgers)
W69-04808

WATER LAW AND PRIVATE DECISION MAKING: A CRITIQUE,
Indiana Univ., Bloomington.
For primary bibliographic entry see Field 06B.
W69-04839

THE INTERSTATE COMMISSION ON THE DELAWARE RIVER BASIN; A STUDY OF ITS ROLE AS A PLANNING AGENCY ENGAGED IN THE POLITICAL PROCESS,
Maynard M. Hufschmidt.
The Interstate Commission on the Delaware River Basin, Mar 1956. 102 p, 6 tab, 175 ref, 1 append.

Descriptors: *Delaware River Basin Commission, *Interstate commissions, *River basin commissions, *Political aspects, Interstate compacts, Short-term planning, Water policy, River basin development, Future planning (Projected), Long-term planning, Water pollution control, Water allocation (Policy), Planning, Evaluation, Political constraints, Federal governments, State governments, Institutional constraints, Federal-state water rights conflicts.

A thorough discussion of the Interstate Commission on the Delaware River Basin, or Incodel, is presented. The background of Incodel is discussed in light of the problems which brought it into existence. Both the long-term and short-term planning functions of Incodel are examined. It is concluded that Incodel was more effective in dealing with immediate problems than in formulating and implementing comprehensive plans. The political composition of the Commission and its action in the political process, both state and national, are discussed in detail. The responsibility and effectiveness of Incodel as an interstate commission in the field of water resources are analyzed. It is concluded that in order to attain effectiveness, interstate water agencies must have broad authority, and to achieve responsibility, such agencies must have a membership directly responsible to state governments. The author notes that the greatest utility of agencies like Incodel, with only advisory powers, is in alerting state and local governments to the problems and opportunities involved in interstate river systems. (Pfeiffer-Fla)
W69-04856

CAIRO PICKLE CO V MUGGRIDGE (BRINE DISPOSAL POLLUTION BY UPPER RIPARIAN OWNER).
206 Ga 80, 55 S E 2d 562-564 (1949).

Descriptors: *Georgia, *Riparian rights, *Brine disposal, *Water pollution, Water rights, Industrial wastes, Chemical wastes, Odor, Fishkill, Remedies, Legal aspects, Judicial decisions, Water law, Waste water disposal, Waste disposal, Pollutants, Damages.

Defendant corporation was dumping approximately fifty thousand gallons of waste water per day from a pickle plant into a non-navigable creek. Several lower riparian land owners sought to enjoin defendant from allowing waste waters to flow into the creek. At a hearing, the evidence showed that during dry seasons, when the water in the creek was low, the discharged waste water caused an offensive odor, killed the fish in the creek, and caused some cattle and hogs of lower riparian land owners to refuse to drink the creek water. After some delay, an order was entered granting a temporary injunction. Defendant sought vacation of the order. The court held that the trial judge did not abuse his discretion in granting the temporary injunction. The owner of land is entitled to the use of water of a non-navigable stream flowing through his land, but lower riparian landowners may join in a petition to restrain an upper proprietor from adulterating the water and thus preserve their correlative right to a reasonable flow of non-polluted water. (Gabrielson-Fla)
W69-04857

CLARK V LINDSAY LIGHT AND CHEMICAL CO (RIPARIAN RIGHTS IN WATERS OF STREAM).
405 Ill 139, 89 NE 2d 900-903 (1950).

Descriptors: *Usufructuary right, *Riparian rights, *Streams, *Ownership of beds, Judicial decisions, Illinois, Legal aspects, Natural streams, Water pollution, Stream pollution, Jurisdiction, Water rights.
Identifiers: *Freehold estate, Injunctions (Prohibitory).

Plaintiffs originally brought suit to enjoin defendant from polluting a stream which ran through plaintiff's land. After the chancellor dismissed this action, plaintiff prosecuted a direct appeal to the Illinois Supreme Court on the assumption that a freehold was involved. In transferring plaintiff's cause, the court held that an action to enjoin pollution of a stream by riparian owner did not involve a 'freehold' so as to authorize a direct appeal. Rather, a riparian owner has no property in the water of a running natural stream, but he has a 'usufruct' in the water as it passes, which is an incident to his ownership of land; that is, a property right exists in the flow of water at that place for all beneficial uses that may result from it. (Logan-Fla)
W69-04858

LEGAL ASPECTS OF OFFSHORE OIL AND GAS OPERATIONS,
Oliver L. Stone.
Nat Resources J, Vol 8, No 3, pp 478-504, July 1968, 27 p, 92 ref.

Descriptors: *Oil industry, *Continental shelf, *Treaties, *Submerged lands act, Exploitation, Exploration, International waters, Drilling, Natural gas, Federal jurisdiction, International law, Foreign waters, Federal government, Continental slope, United Nations, Coastal areas, Offshore platforms, Florida, Texas, Alabama, Louisiana, California, Beds, Legislation.

The broad areas of law affecting offshore oil and gas operations are discussed. The areas touched are relevant to state, national, and international interests. On the national level, there has been a growing controversy as to the ownership of the submarine areas off the coast; as between the state and federal governments which has the better right. The Submerged Land Act of 1953 vests title to such areas in the coastal states. Another problem area dealt with is that relative to the Continental Shelf. The 1945 Proclamation on the Continental Shelf extended national jurisdiction out to a depth of 600 feet. The Outer Continental Shelf Lands Act of 1953 enacted into law the 1945 Proclamation. On the international level, the Convention on the Continental Shelf was approved by the United States in 1960 and went into effect in 1964. It extends national jurisdiction over submerged land out to a depth of 200 meters. Many other problems, however, have not as yet been resolved, including

the exploitation of the sub-soil of the highs and jurisdiction and control of the ocean floor. Finally, there is a dispute as to what law is applicable on the outer Continental Shelf. (Heckerling-Fla)
W69-04859

RIPARIAN RIGHTS... ACTION BY STATE TO ENJOIN LANDOWNER FROM FILLING IN LAKE.
Albany Law School, N. Y.

Albany L Rev, Vol 32, No 3, pp 677-682, Spring 1968. 6 p, 23 ref.

Descriptors: *Vermont, *Riparian rights, *Low water mark, *Ownership of beds, Riparian lands, High water mark, Public lands, Dikes, Navigable waters, Boundaries, Banks, Water law, Judicial decisions.

Defendants constructed a dike on a lake immediately in front of their shore property. The state sought to enjoin construction as an encroachment on state land. The trial court held the average of the lowest water levels reached over a period to be the ordinary low-water mark. This constitutes the boundary between public and riparian land, and defendants had not encroached. The supreme court, on this basis, stated that the test stated by the lower court was for the extraordinary low water mark, but it did not reverse the case on this theory. The case was said to turn on the right of the public to use the water regardless of ownership of the bed. The decision is criticized as being based on improper interpretation of precedent and as representing a shift in state policy with regard to riparian rights. State power to control water use may be based either on ownership of beds of navigable waters or on a claim to an easement. The rule that the riparian owner owns land to the low water mark is threatened if the state claims the right to control the use of water between the high and low water marks regardless of ownership. (Helwig-Fla)
W69-04860

THE ROLE OF U S TRANSPORTATION POLICY IN THE DEVELOPMENT OF INLAND WATERWAY NAVIGATION,
P. E. Franklin.
International Conference on Water for Peace, Vol 7, pp 944-951, 1968. 8 p. For 8 volume Proceedings see Vol 2, No 9, Field 06B, W69-03305.

Descriptors: *Inland waterways, *Transportation, *Multiple-purpose projects, *Navigation, Channels, Canals, River basin development, Water resources development.

Commercially navigable waterways in the U S total about 25,000 miles. Inland water transportation accounts for 15% of the tonnage and 10% of the ton miles of the inter-city freight traffic. Petroleum is the leading commodity transported. Major waterway traffic has increased 300% since 1945. Other facts and historical data are given. Canals developed rapidly int the U S until the introduction of the railroad. The waterway system has been compteitive because there is no direct cost to the carrier and there has been little ICC regulation. These factors are the main current policy issues concerning the system. Multi-purpose river basin projects combining navigation, irrigation, power generation, flood control, drought control, bank control, pollution control and recreation are in progress, stimulating regional development. The major problem facing the waterway system is its secondary role in water resources planning. The problem can best be met through the multi-purpose water basin projects on an inter-agency cost-sharing basis. The Department of Transportation and the Water Resources Council are developing criteria for a benefit/cost ratio to justify public investment in the system. (Helwig-Fla)
W69-04862

BARBER PURE MILK CO V YOUNG (OBSTRUCTION OF SURFACE WATER FLOW).
81 So 2d 328-331 (Ala 1955), aff'g 81 So 2d 324-328 (Ct App Ala 1954).

Descriptors: *Alabama, *Natural flow doctrine, *Obstruction to flow, *Surface runoff, Water law, Streams, Culverts, Overflow, Judicial decisions, Streamflow, Alteration of flow, Ditches, Diversion, Running waters.
Identifiers: *Negligence, Nuisance.

Plaintiff brought action for damages for negligence of adjoining owner in causing water to overflow onto plaintiff's property. The complaint arose upon defendant's construction of a straight channel in place of an old meandering watercourse with resulting clogging of a culvert into which both the old and substituted channels were connected. The entire project of relocating the ditch was carried out by independent contractors. The appellate court affirmed the lower decision in favor of plaintiff. After defining surface water as 'water casually on land from natural precipitations and flowing in no fixed channel,' the court observed that the following maxims apply to both surface water and stream diversion: (1) Property should be used so as not to injure that of another; (2) Water ought to flow in its natural path. The court held that negligently obstructing the flow of waters, so as to divert its natural flow to the injury of others, constituted a tort in the nature of a private nuisance. The question of foreseeability was held to be properly for the jury, and the question of who performed the work irrelevant. (Wheeler-Fla)
W69-04863

MCHENRY V FORD MOTOR CO (EROSION BY WATERS OF RESERVOIR).

146 F Supp 896-905 (ED MKH 1956).

Descriptors: *Michigan, *Erosion, *Impounded waters, *Easements, Water storage, Water rights, Water levels, Watercourses, Erosion control, Flooding, Flood damage, Reservoirs, Reservoir operation, Rivers, Impoundments, Right-of-way, Boundaries, Competing uses, Judicial decisions, Riparian rights, Legal aspects.
Identifiers: Huron River, Easement of flowage.

Plaintiff owned about 190 acres of land bordering Michigan's Huron River. In 1925, plaintiff conveyed 155 acres of this tract to defendant with concomitant flowage rights. Included in the deed to defendant was a restrictive use covenant providing that no part of the land deeded should be used in any manner which would render the remaining 35 acres undesirable for 'high-class' residence purposes. The land was purchased for the express purposes of creating a reservoir. Natural action of the impounded waters eroded part of the 35 acres retained by the grantors. Plaintiff then brought suit to enjoin this alleged flooding and erosion and for damages. Defendant moved for summary judgment on the ground that the rule of Rylands v Fletcher, relied on by plaintiff was not applicable in Michigan. The motion was granted. (Carruthers-Fla)
W69-04864

STATE V ANDERSON (ACTION TO ESTABLISH FLOWAGE EASEMENT).

87 N W 2d 839-844 (Minn 1958).

Descriptors: *Easements, *Minnesota, *Condemnation, *Flood damage, Judicial decisions, Legal aspects, Backwater, Flood routing, Dams, Eminent domain, Control structures, State governments, Rivers, Damages, Flood control, Project planning.

In order to control waters in the Minnesota Valley, the State had erected a series of control works on the Minnesota River. Because of these control works, including dams, plaintiff's property became flooded periodically. The State brought condemnation proceedings. Plaintiff filed petition in intervention to recover damage from the State for the taking of land. The lower court ruled that the State had taken a flowage easement upon plaintiff's land to a certain elevation, and awarded damages. The Supreme Court of Minnesota affirmed. The decision concerned mostly the attack by the State as to whether the evidence was sufficient to sustain the finding of the easement. The court ruled also that the imposition of an easement did not involve usurpation of legislative power. (Wheeler-Fla)
W69-04865

LIPPMAN V HUHN (RIGHT TO ESTABLISH PUBLIC DRAINAGE DITCHES).
81 N W 2d 100-109 (Minn 1957).

Descriptors: *Minnesota, *Drainage, *Ditches, Legislation, Judicial decisions, Legal aspects, Water law, Laterals, Drainage systems, Natural streams, Natural watercourses, Drainage districts, Public benefits.

Pursuant to the procedure outlined in the Drainage Code, respondent Lippman filed a petition and received a final order from the district court for establishment of Lateral A and its outlet into previously established Judicial Ditch no 13. Appellant, Huhn, questioned the validity of the final order. Appellant claimed that Lateral A would drain a watershed area different than the area served by Judicial Ditch no 13, that it would require diverting the natural drainage system previously draining the area, and that the only groups to be benefited by its establishment would be its proponents. However, the court upheld the final order, saying that lateral A was justified by the fact that it would promote the general health and public welfare and be of public benefit, this being the purpose behind the enactment of the drainage code. (Holt-Fla)
W69-04866

STATE V PUBLIC SERVICE COMM'N (RECREATION FACILITIES).
For primary bibliographic entry see Field 06B.
W69-04867

RUBIN V STATE (DRAINAGE WATER DIVERSION).
168 N Y S 2d 378-384 (NY Ct Cl 1957).

Descriptors: *New York, *Condemnation, *Highway effects, *Drainage water, Legal aspects, Judicial decisions, Highways, Surface runoff, Surface waters.

Plaintiff is the owner of land on which she operates a hotel. Defendant appropriated, by condemnation proceeding, certain portions of the land and nearby adjacent land for purposes of a thruway overpass. Plaintiff sought payment for certain consequential damages resulting from the taking, having already been compensated for the value of her property. The court allowed a recovery in favor of the plaintiff as compensation for an increased flow of drainage water upon her land caused by the construction of an embankment by the defendant as part of the thruway project. (Molica-Fla)
W69-04868

BOSTICK V SMOOT SAND AND GRAVEL CORP (DREDGING IN RIVER AS CREATING NUISANCE FOR OTHER RIPARIAN OWNERS).
154 F Supp 744-767 (D Md 1957).

Descriptors: *Riparian rights, *Virginia, *Interstate rivers, *Dredging, Judicial decisions, Maryland, Industries, Ownership of beds, Riparian land, State governments, State jurisdiction, Rivers, River beds, Navigable rivers, Legal aspects, Legislation.

Plaintiffs, landowners in Virginia, brought suit against defendant gravel company for an injunction and for damages stemming from drilling operations

in the Potomac River, upon which their property abutted. The State of Maryland granted defendant a license to dredge sand, gravel, and other materials between the low water mark and the outer line of the channel on the Virginia side. The court recited the applicable state statutes, the history of disputes and agreements between the two states, judicial considerations and the opinions of the attorney general. It held that the plaintiffs had no cause of action against defendant because the Maryland statute, which granted riparian owners of lands bordering on any navigable rivers, the right to dredge sand, applied only to Maryland property owners, not to landowners in Virginia. Injunctive relief was denied. The dredging operation was also held not to constitute a nuisance. (Heckerling-Fla)
W69-04869

KOCH V WICK (PRIVATE OWNER MAY ENJOIN COUNTY'S ATTEMPT TO USE GROUNDWATER ON OTHER THAN OVERLYING LAND).
87 So 2d 47-49 (Fla 1956).

Descriptors: *Florida, *Wells, *Overlying proprietor, *Reasonable use, Judicial decisions, Competing uses, Water rights, Legal aspects, Water allocation (Policy), Relative rights, Water utilization, Water transfer, Percolating water, Groundwater, Local governments, Municipal water, Beneficial use, Consumptive use, Withdrawal, Preferences (Water rights).

Plaintiff, a landowner, sought an injunction preventing the defendant county commissioners from using adjoining lands as a municipal well field for supplying water to land areas not overlying the well field. The county had leased four acres adjoining plaintiff's 2600 acre tract and was pumping in excess of 4,000.000 gallons of water daily from this 4 acre site for sale in surrounding county municipalities. Plaintiff alleged that his orange groves would soon become a wasteland if the county was permitted to draw off such quantities of percolating groundwaters for commercial purposes. This court reversed and remanded the lower court's decision for defendant. The county was not in a favorable position merely because the water it pumped was for a public use. The county as a lessee was bound by the rights possessed by the owner-lessor to draw only so much water from beneath the surface of its tract as could be deemed reasonable and in accordance with the beneficial use of that amount of land. Plaintiff could not be made to wait until the extent of damages could be ascertained before being permitted to seek injunctive relief from damage. (Blunt-Fla)
W69-04870

OBSTRUCTING AND PREVENTING FISH FROM RUNNING UP RIVERS OR CREEKS; POISONING STREAM OR USING EXPLOSIVES TO CATCH FISH.
Ala Code tit 8, secs 78-79 (1958).

Descriptors: *Alabama, *Fish barriers, *Fishkill, Legislation, Fish, Fish management, Fish passages, Fish conservation, Dams.

Section 78 imposes a fine of not more than $100.00 for preventing the passage of fish up the waters of any river or creek by means of any obstruction other than a dam on a non-navigable stream for impounding private waters. Section 79 imposes a fine of $50 to $200 for the taking or attempting to take fish by means of poison or explosives. Section 79 (1) imposes fines of $50 to $200 for the taking or stunning of fish by electrical equipment or any other device not expressly authorized. Possession of any such device on the bank of any public water or in a boat on such water is prima facie evidence of its illegal use. (Kahle-Fla)
W69-04871

LIBBY, MCNEIL AND LIBBY V ROBERTS (INTERFERENCE WITH NATURAL DRAINAGE COURSE).
110 So 2d 82-85 (2d DCA Fla 1959).

Descriptors: *Florida, *Natural streams, *Drainage water, *Surface drainage, Surface waters, Surface runoff, Judicial decisions, Water law, Lakes.
Identifiers: *Natural drainage course, *Artificial drainage course.

Plaintiffs, owners of property on the bed of a body of water known as Little Everglades, built culverts and ditches to drain its waters, which ultimately flowed through a natural drainage course on defendant's land. Defendant, not wanting the level of the waterbody to be lowered, dammed the drainage course. Plaintiff was successful in enjoining defendant from destructing the drainage from plaintiffs' lands, and defendant appealed. The appellate court found Little Everglades to be surface water or a watercourse, but not a lake. This conclusion was reached after definitions of 'surface water,' 'natural watercourse' and 'lake' were set forth. As to plaintiff's right to link artificial drains into the natural drainage course running through defendant's property, it was held that an increase in the volume of water caused thereby is not actionable on the part of the owner of a lower estate, even though the increased volume makes the stream exceed the capacity of its channel. (Patterson-Fla)
W69-04872

LIABILITY, AS REGARDS SURFACE WATERS, FOR RAISING SURFACE LEVEL OF LAND,
W. E. Shipley.
12 ALR 2d 1338-1352 (1950).

Descriptors: *Repulsion (Legal aspects), *Civil law, *Surface runoff, *Reasonable use, Surface waters, Natural flow, Drainage water, Adjudication procedure, Easements, Judicial decisions, Proprietary power, Urban sociology, Remedies.

The legal problems arising when surface water is diverted by improvements resulting in a general elevation of the land are discussed. Many courts have adopted what is called the 'common enemy' rule, under which each landowner is entitled to take whatever steps he sees fit to protect his land from the flow of surface water. In these jurisdictions, including Kansas, Mass, Mo, N J and N Y any act of either an upper or lower owner in raising the surface of his land will not create any liability. In some jurisdictions the 'common enemy' rule has been modified by the doctrine of 'reasonable use' -- property must be used so as not to unnecessarily injure others. These jurisdictions include Mo, Del, Va, and N Y. Georgia, Ky, Md, Tenn, and Texas have adopted the civil law rule that lower land must accept natural drainage from upper land. The upper owner cannot change the flow so as to cause drainage upon the lower land in a different place or volume. In several jurisdictions it has been held that the 'common enemy' rule is preferable where urban property is involved since its enjoyment depends upon the ability to improve by raising its surface. Cases from Ala, Ark, Kan, N Y, Pa are discussed. (Kahle-Fla)
W69-04873

FISCHER V TOWN OF ALBIN (TOWN MAY NOT ALTER DRAINAGE DISTRICT WITHOUT CONSIDERING RIGHTS OF DISTRICT LANDOWNERS).
104 N W 2d 32-35 (Minn 1960).

Descriptors: *Minnesota, *Drainage systems, *Benefits, Judicial decisions, Estimated benefits, Project benefits, Alteration of flow, Relative rights, Assessments, Appreciation, Culverts, Roads, Cities.
Identifiers: Constitutional law.

Plaintiffs, owners of land within a drainage district, brought suit to require the defendant town to remove certain culverts placed in a township road adjacent to the plaintiffs' property. The plaintiffs claimed that the town culverts altered the condition of the existing drainage district. The town claimed that its culverts did not, in any way, affect the property rights of the plaintiffs. The lower court ordered the town to remove its culverts, and this court affirmed the decision. Owners of land within a drainage system who have been assessed for the benefits drained from its construction have a vested property right in the maintenance of the system in the same condition as when it was originally established. This right extends not only to the ditches themselves but to all of the conditions shown to have existed at the time the system was established and upon which the project was founded and assessments made. The town may not defeat the plaintiffs' property right in the system as it originally existed by claiming that some of the benefits which accrued to plaintiffs by virtue of the system were not foreseen when the system was completed, and hence cannot be protected now. (Blunt-Fla)
W69-04874

FOURTH CLASS CITIES - SEWER BONDS.

Mich Comp Laws Ann sec 115.1 (1967).

Descriptors: *Michigan, *Cities, *Financing, *Local government, Legislation, Debt.
Identifiers: *Bonds, *Ratification.

All sewer bonds heretofore attempted to be authorized by any fourth class city pursuant to sections 3308, 3309, and 3313 of the Compiled Laws of Michigan are hereby declared to be legal and binding obligations if approved by 2/3 of the electors voting in the city with ten days notice. Any defects of form in enabling ordinances or notices will not invalidate such bonds if within statutory limits. (Harris-Fla)
W69-04875

HOME RULE CITIES - BORROWING FOR PUBLIC WORKS.

Mich Comp Laws Ann sec, 117.4a, 117.4b, 117.4e, 117.4f, 117.4h (1967).

Descriptors: *Michigan, *Cities, *Public utilities, *Local governments, Financing, Flood control, Navigable water, Bridges, Dams, Water supply, Sewage system, Parks, Recreation, Levees, Conduits, Riparian rights, Riparian land, Docks, Easements, Legislation, Legal aspects.
Identifiers: *City charters.

Each city may in its charter provide for: (1) borrowing money for relief and preservation of property in case of floods or calamity; (2) refunding money advanced on assessments imposed for water main extensions; (3) installation of sewers and waterworks; (4) acquisition of public parks, recreation grounds, public landings on navigable waters, levees, embankments, waterworks and sewage systems; (5) the purchase or condemnation of public utility property or franchises. Each city may provide for: (1) contracts to own and operate existing public utilities if approved by the electors; (2) domestic, commercial, and municipal utility service, (3) acquisition and operation of sewage disposal systems within or without corporate limits; (4) fixing charges for services, including return on the fair value of property devoted to service; (5) use of property located in streets and public places by utilities; (6) control of watercourses within its boundaries, but not to conflict with the law thereunder where a navigable stream is dammed or bridged, or with riparian or littoral rights outside corporate limits; (7) securing easements in property abutting or adjacent to navigable streams for construction of pedestrian or vehicular passageways; and (8) for acquiring and operating facilities for docking of pleasure craft and hydroplanes within corporate limits. (Harris-Fla)
W69-04876

PUBLIC PARKS - PLAYGROUNDS - JOINT PARKS.

N J Stat Ann secs 40:61-27 to 40:61-29 (1967).

Descriptors: *Legislation, *New Jersey, *Recreational facilities, *Cities, Outdoor recreation, Local governments, Project purposes, Contracts, Lakes, Ponds, Public recreation, Legal aspects, Public benefits, Streams.

Municipalities in the same or adjacent counties may cooperate in providing public parks, resorts, and recreation areas. Any municipality may contract with any other municipality for improvement of banks and shores as places for public recreation. Such contracts are to include provisions necessary to fulfill the joint improvement. Any two or more municipalities lying within adjacent counties may acquire land, lakes, streams, and other rights and may erect and maintain dams to impound water. Such land, lakes and streams shall be maintained as public parks and recreation areas. In order to acquire land, lakes, streams and other rights for public purposes, the governing bodies of the municipalities may, by majority vote, pass an ordinance adopting the previously mentioned provisions. (Stewart-Fla)
W69-04877

PUBLIC PARKS - PLAYGROUNDS.
N J Stat Ann sec 40:61-22.20 (1967).

Descriptors: *Legislation, *New Jersey, *Recreation facilities, *Cities, Beaches, Outdoor recreation, Swimming, Access routes, Land use, Safety, Local governments, Regulation, Legal aspects, Financing, Eminent domain, State governments, Erosion control.

The governing body of any municipality bordering on the Atlantic Ocean or bay areas shall have the right to exclusive control, and care of any boardwalk, bathing, and recreational facilities. The municipality must acquire and own the lands. In addition, such municipality may, by ordinance, make and enforce rules and regulations for the government and policing of such lands, boardwalk, bathing facilities and equipment; provided, that such power of control, government, and policing shall not be construed to exclude or interfere with state law or authority with respect to such lands, property, and facilities. The municipality may, in order to provide funds to improve, maintain, and police the area and protect it from erosion or encroachment, and to provide facilities and safeguards for public bathing, by ordinance make and enforce rules and regulations and provide for charging of reasonable fees of persons using the facilities as well as access to the beach. No fees shall be charged or collected from children under twelve. (Stewart-Fla)
W69-04878

TRANSPLANTING OF SHELLS AND OYSTERS.
N J Stat Ann sec 50:1-14 (1955).

Descriptors: *Legislation, *New Jersey, *Shellfish, *Oysters, Commercial shellfish, Dredging, Reproduction, Administrative agencies, Regulation, Legal aspects.
Identifiers: *Shellfish transplanting, Oyster bed.

Whenever the board deems it necessary for propagation purposes, it may plant shells upon any oyster bed or may dredge and transplant shells and oysters from one bed to another, employing boats or vessels propelled either by sails or mechanical power. The board may purchase oysters from another state and plant them on the natural oyster beds of this state for the benefit of seed production. (Heckerling-Fla)
W69-04879

LYTLE V PENNSYLVANIA RR (BRIDGE CONSTRUCTION AND OBSTRUCTION TO FLOW).

108 N E 2d 72-76 (Ct App Ohio 1951).

Descriptors: *Ohio, *Flooding, *Bridges, *Bridge design, Obstruction to flow, Natural flow doctrine, Floods, Relative rights, Rainfall, Judicial decisions, Legal aspects, Streams, Damages, Backwater.
Identifiers: *Acts of God, *Duty of care, *Negligence, Proximate cause.

Property of the plaintiff was damaged by overflow from a natural watercourse. Plaintiff alleged negligence by the defendant railroad company in constructing a new bridge across the watercourse which passed through plaintiff's land. During a heavy rain, water backed up onto plaintiff's land. Plaintiff claimed this backup was due to the fact that the bridge, as constructed, interfered with the flow of water. A jury verdict was in favor of the plaintiff, and defendant appealed. The court of appeals held that a duty desolves upon the builder of a bridge to maintain openings for the natural flow of water and to exercise reasonable care to prevent such floods as may be expected to occur. The duty owed is one of due care in guarding against reasonably foreseeable flooding and does not extend to extraordinary or unprecedented flood. In order to affix liability, it must be shown that negligence concurred with the act of God in causing injury. If injury would occur without the negligence, then it cannot be the proximate cause of the damage. An instruction to this effect was erroneously refused below. (Harris-Fla)
W69-04880

COUNTY CONTROL OF DAM CONSTRUCTION.

Mich Comp Laws Ann secs 46.21, 46.22 (1967).

Descriptors: *Michigan, *Obstruction to flow, *Dam construction, *Navigable waters, Local governments, Legal aspects, Water law, Streams, Bridge construction, Bridges, Boats, Regulations, Boating regulation, Administrative decisions, Legislation.

The board of supervisors of the several townships and cities have the power to regulate bridge and dam construction across navigable streams. They also have the power to provide for removal of any obstructions in a stream, and to direct the time and places where boats, logs, and rafts shall remain or be removed. Penalties may be imposed to enforce regulations. Any party wishing to construct a dam across a navigable stream must file a petition with the board of supervisors detailing the dam's description and purpose. Notice by newspaper and registered mail must also be given to all persons whose lands will be affected by such dam. The board shall hold a hearing before granting or denying permission to construct the dam. Once permission is granted, the dam is built, if such dam subsequently is destroyed, the petitioners or their heirs or assigns may reconstruct the dam according to the original specifications without making re-application to the board. The board has no power to grant the right to any petitioners to injure the lands of any person as a result or consequence of constructing a dam. (Holt-Fla)
W69-04881

LEASED UNITED STATES LANDS; APPROPRIATION FOR FLOOD CONTROL.
Mich Comp Laws Ann sec, 45.491 (1967).

Descriptors: *Financing, *Flood control, *Michigan, *Navigation, Water law, Legal aspects, Appropriation, Local governments, Federal government.

All sums of money received from the United States under an act of Congress providing for 75 per cent of all moneys received for leases of land situated within the various states to which the United States owns fee simple title for flood control and navigational purposes is to be appropriated to the board of supervisors of the county in which the land is situated. The board shall expend the money in accordance with the acts of Congress providing for distribution to states and counties. Within a reasonable time of receipt of the money, the state treasurer shall issue his warrant to the treasurer of the county entitled thereto. (Holt-Fla)
W69-04882

FENCES ACROSS WATER; NEGLECT, REMEDY.
Mich Comp Laws Ann sec 43.16 (1967).

Descriptors: *Michigan, *Bodies of water, *Riparian rights, Construction, Legislation, Remedies, Legal aspects, Maintenance, Construction costs, Replacement costs.
Identifiers: *Fences.

Where it becomes necessary to construct a partition fence running into the water, the same shall be constructed in equal shares, unless otherwise agreed by the parties, and in case either party shall refuse or neglect to make or maintain the share belonging to him, similar proceedings shall be had, as in case of other fences, and with the like effect. (Shevin-Fla)
W69-04883

SOUTHLAND V AARON (RIPARIAN OWNER'S ACTION FOR DAMAGES FROM OIL WASTE POLLUTION OF STREAM).

80 So 2d 823-827 (Miss 1955).

Descriptors: *Water pollution, *Riparian rights, *Waste disposal, *Mississippi, Streams, Riparian land, Legal aspects, Artificial use, Oil wastes, By-products, Pollution abatement, Water pollution control, Judicial decisions.

The original action was brought to recover damages suffered by appellee Aaron due to pollution of appellee's water supply by appellant's upstream operation of a gasoline refinery. Appellant continued to pollute the stream after the original judgment for appellee. This appeal was taken from a second suit, and was based upon an alleged error by the trial court in allowing punitive damages and greater damages than requested by appellee. After a discussion of the procedure in the lower court, the appellate court found that the error below was harmless, and that appellant's continued pollution of the stream constituted a nuisance. The court found willful misconduct despite the construction by appellant of ponds to control the escape of petroleum products into the stream, since they were inadequate. (Kelly-Fla)
W69-04884

SEWERS AND DRAINS.
N J Stat Ann secs 40:96-1 to 40:96-10 (1967).

Descriptors: *New Jersey, *Legislation, *Sewage districts, Sewage systems, Sewers, Sewage, Outlets, Cesspools, Drains, Surveys, Assessments, Legal aspects.

Chapter 96 deals with the incorporated camp meeting associations or seaside resort areas and their procedures, plans, etc, for construction of district sewerage systems. These districts consist of one or more main sewers with the necessary branches or connections, the main or principal sewers having their outlet in the ocean or other proper place. The board authorized to handle this work has the following powers and obligations: to require that plans and specifications be prepared showing size, location, depth below the surface, and inclination of the proposed sewers; to assess the cost of local and main sewers and outlets therefor upon the real estate benefited; to provide for the construction of proper house and privy connections and branches leading into all main or branch sewers; and require owners of any cesspool, drain, privy, water closet, or accumulation of water or sewage matter which is prejudicial or injurious to public health to drain, alter or improve its condition. (Logan-Fla)
W69-04885

CANALS AND CANAL BEDS.
N J Stat Ann secs 40:67-47, 40:67-48 (1967).

Descriptors: *New Jersey, Legislation, State governments, Canals, Beds, Public rights, Cities, Navigation, Transportation, Legal aspects.

A municipality in which a canal or canal bed lies, in whole or part, has the power to vacate or release all public rights - in that canal or canal bed by ordinance. Prior to exercise of this power, the following facts must be found: (1) The canal or canal bed is not vested in any public body (State, Municipal, etc.); (2) It has not been used for navigation purposes for a period of twenty years or more; and (3) that the public interest will not be injured by this release. Also, such ordinance will be filed in the land recording office. (Logan-Fla)
W69-04886

COMMONWEALTH EX REL SHUMAKER V NEW YORK AND PENNSYLVANIA CO, INC (JURISDICTION OF SANITARY WATER BOARD OVER STREAM POLLUTION).
61 Dauphin County Reports 156-172 (CP Pa 1949).

Descriptors: *Water pollution, *Pollution abatement, *Pennsylvania, Water pollution treatment, Judicial decisions, Legal aspects, State jurisdiction, Industrial wastes, Pulp wastes, Administrative agencies, Permits, Acids, Organic wastes, Streams.
Identifiers: *Sanitary water board, *Pure streams law.

Plaintiff sought an injunction to restrain the defendant from discharging industrial waste into a river on the grounds of public nuisance. The sanitary water board had found the alleged pollution to be minimal and not of such degree as to warrant labeling as a public nuisance under the Pure Streams Law of Pennsylvania, PL 1987 (1937), and refused to enjoin the defendant's pulpmill from operation. Plaintiff contended that under the Pure Streams Law, the court has the authority to declare the existence of a public nuisance and grant proper relief. The court held that the legislature intended the Sanitary Water Board to have exclusive jurisdiction over public nuisance determinations under the Pure Streams Law and accordingly dismissed the bill. (Katz-Fla)
W69-04887

SAWYER V SHADER (OBSTRUCTION TO FLOW).

75 N E 2d 647-649 (Mass 1947).

Descriptors: *Massachusetts, *Flooding, *Surface drainage, *Obstruction to flow, Natural stream, Damages, Remedies, Legal aspects, Judicial decisions, Water law, Backwater.

Plaintiff had purchased a low from defendant. This lot was drained by a natural watercourse which ran across defendant's adjacent lot. Plaintiffs sought to restrain defendant from obstructing the watercourse and to compel the removal of existing obstructions allegedly placed in the stream by defendant. Plaintiff also sought damages for flooding allegedly caused by defendant's acts. The case was referred to a master who, after hearing, found that the filling of the watercourse was due to natural causes and was in no way attributable to acts of defendant. After overruling plaintiff's exception to the findings of the master, the judge confirmed the report and entered a decree dismissing the bill. Plaintiffs appealed. The court assumed that the master established that both parties had rights and obligations incident to the watercourse flowing through their respective properties even though no mention of such rights was made in plaintiff's deed. But the court found no inconsistency between this finding and the master's ultimate finding that defendant's actions had no appreciable effect on the watercourse and that the flooding of which plaintiffs complained was due to natural causes. (Gabrielson-Fla)
W69-04888

CRAWFORD V SPRINGVIEW CORP (SURFACE DRAINAGE OVER LOWER ADJACENT TRACT).
39 Delaware County Reports 356-361 (CP Pa 1952).

Descriptors: *Pennsylvania, *Drainage effects, *Natural flow, *Surface runoff, Watersheds, Surface waters, Drainage, Drainage systems, Water conveyance, Reasonable use, Relative rights, Slopes, Topography, Drainage practices, Judicial decisions, Legal aspects, Ditches, Culverts, Landfills, Diversions, Alternation of flow.

Plaintiff owned land adjacent to property upon which defendant corporation constructed a housing subdivision. Plaintiff claimed that land filling operations carried on by defendant had changed the natural grade of the land to such an extent that drainage of surface water was impaired and that the natural flow had been diverted onto plaintiff's farmland. The court found that some surface water had drained naturally onto plaintiff's land before defendant had begun construction. Defendant had the right to make reasonable use of its land so long as surface runoff was not diverted from its natural course or substantially altered in quantity or quality. The court decided that the increase in volume of surface drainage onto plaintiff's property was not of a substantial character and that the condition, as it existed, did not warrant injunctive relief. Damages to plaintiff's land were nominal. The court further found that while the municipality of Springview could compel defendant to construct storm drains to prevent surface runoff, there was no legal requirement that such action be taken. (Kelly-Fla)
W69-04889

BISHOP V RICHARD (OBSTRUCTION OF DRAINAGE BY LOWER LANDOWNER).
65 A 2d 334-337 (Md Ct App 1949).

Descriptors: *Maryland, *Natural flow, *Drainage, *Obstruction to flow, Ditches, Slopes, Surface runoff, Reasonable use, Judicial decisions, Legal aspects, Relative rights, Topography, Surface water, Drainage practices, Barriers, Water conveyance, Conduits, Watersheds, Drainage systems, Drainage effects.

Appellant owned land adjacent to, and lower than, appellee's land. Surface runoff caused by falling rain and melting snow had naturally drained from appellee's higher land over appellee's land and into a river for at least thirty years. A series of well-defined ditches extended across appellant's land through which the water had naturally drained. Appellant refused to remove debris from the ditches, forcing backwater to accumulate on appellee's land. The court found that since the natural slope of the land favored drainage across appellant's property, the latter could not impede the flow of water so as to cause accumulation on appellee's land. Maryland adheres to the 'civil law rule,' under which the upper land owner has the right to have water drain from his land in its natural course over lands of a lower landowner. In assessing the propriety of such 'right' in a given case, the reasonableness of the upper landowner's use of his land is taken into account. In the instant case, the court found no detriment to the lower landowner in permitting appellee to keep the drainage ditches clean and unimpaired. (Kelly-Fla)
W69-04890

GIBSON V SHARP (DRAINAGE DITCH RIGHT OF WAY)
277 S W 2d 672-680 (Mo Ct App 1955).

Descriptors: *Obstruction to flow, *Ditches, *Missouri, *Surface drainage, Standing waters, Culverts, Easements, Right of way, Drainage water, Drainage systems, Laterals, Surface waters, Repulsion (Legal aspects), Riddance (Legal aspects), Water conveyance, Judicial decisions, Legal aspects, Relative rights, Damages, Permits, Prescriptive rights.
Identifiers: Implied easements, Estoppel, Prescriptive easements, Remote grantees.

Plaintiff sought an injunction restraining defendants from obstructing a ditch carrying surface runoff from plaintiff's land across land owned by defendant. The ditch had originally been constructed in 1912 by the parties' predecessors in title and had subsequently been periodically improved by plaintiff's predecessor in title. The court found that a bare license to maintain the ditch ran with plaintiff's tract. However, since plaintiff and his predecessor in title had expended valuable consideration in maintaining the ditch, an equity court would now estop the defendant from obstructing the flow. The court recognized that a contract might also be implied by virtue of the conduct and relation of the parties in regard to the ditch. (Katz-Fla)
W69-04891

GOTT V FRANKLIN (BARRICADE TO NATURAL SURFACE WATER FLOW).

211 S W 2d 680-683 (Ky Ct App 1948).

Descriptors: *Kentucky, *Natural flow doctrine, *Watercourses (Legal), *Obstruction to flow, Water law, Judicial decisions, Damages, Backwater, Surface runoff, Drainage systems, Surface waters, Diversion structures, Relative rights, Ditches, Tile drains, Sewage, Drainage water, Legal aspects.

An open drainage ditch, in existence for more than thirty years, carried surface waters from a boundary of plaintiff's land and across defendant's lower adjacent land. Plaintiff caused increase of the flow through this natural drain by the addition of tile drains. Defendant placed a barricade in the ditch which diverted water onto plaintiff's garden. Plaintiff brought suit, praying for an injunction to compel opening of the ditch. Defendant counterclaimed, alleging that plaintiff was running sewage through the ditch and that the tile drains increased the flow; the relief prayed for was an injunction against both these activities. The lower court ordered removal of the barricade, but refused to order plaintiff to take up the drains. The appellate court affirmed regarding removal of the barricade, but ordered removal of the tile drains also. Evidence of sewage was ruled insufficient. (Wheeler-Fla)
W69-04892

DAVIS V ATLANTIC COAST LINE RR (DRAINAGE FLOW EASEMENTS).
227 NC 561, 42 SE 2d 905-910 (1947).

Descriptors: *North Carolina, *Easements, *Natural flow doctrine, *Surface runoff, Drainage systems, Water spreading, Precipitation excess, Repulsion (Legal aspects), Riddance (Legal aspects), Judicial decisions, Legal aspects, Hydraulic structures, Pipes, Relative rights.

Plaintiff who owned land below that of defendant, brought this action to recover for damage to his property allegedly caused by the wrongful accumulation, acceleration, and diversion of surface water by the defendant onto and over plaintiff's tract. The court held that where two tracts of land adjoin each other, one being lower than the other, the lower tract is burdened with an easement to receive waters from the upper tract which naturally flow therefrom. The upper proprietor may increase the natural flow of water and accelerate such flow as long as he does not divert the water or cause it to flow upon the lands of the lower proprietor in a manner or at a place different from that which is 'natural' under the circumstances. (Katz-Fla)
W69-04893

MASON V LAMB (ACTION TO RECOVER DAMAGES FROM SURFACE WATER RUNOFF ONTO PLAINTIFFS' PROPERTY).
189 Va 348, 53 SE 2d 7-11 (1949).

Descriptors: *Surface waters, *Storm runoff, *Drainage, *Virginia, Relative rights, Watersheds, Drainage effects, Drainage practices, Ditches, Surface runoff, Flood control, Diversion, Surface drainage, Judicial decisions, Legal aspects, Flood damage.

Plaintiffs brought this action seeking damages for injuries to their land and building caused by surface water which was diverted onto their land when defendant filled in a low area on his property. The depression, which filled with water after heavy rains, had been located mainly on defendant's property, but had also extended to plaintiff's property and to parts of other lots. Defendant took no special steps to provide a new drainage receptacle or avenue for collection or conveyance of surface water. During subsequent heavy rains, surface water drained from defendant's lot, among others, and from plaintiffs' own lot into plaintiff's building, causing considerable damage. The court found that under the common law as adopted by Virginia, each landowner may protect his property from surface water damage as he sees fit, so long as he does not act wantonly or carelessly at the expense of other landowners. Plaintiffs failed to show negligence in defendant's filling and grading. The court held that defendant need not maintain a catch basin on his property for plaintiff's benefit. (Kelly-Fla)
W69-04894

FOREST LAND CO V BLACK (ACTION TO ENJOIN OPERATION OF MOTOR BOAT ON PRIVATE LAKE).
57 SE 2d 420-427 (SC 1950).

Descriptors: *South Carolina, *Recreation, *Riparian rights, *Reasonable use, Safety, Legal aspects, Judicial decisions, Competing uses, Water utilization, Lakes, Boating, Regulation.

Appellant, Black, purchased land adjoining a lake from appellee land company. Appellant's deed permitted him to operate a motorboat on the lake, subject to any reasonable restrictions on its use which appellee should make. Appellee attempted to permanently enjoin appellant from operating his boat on the lake, alleging that the use of any motorboat constituted a nuisance because of noise, disturbance of fish beds, and erosion of shoreline and beaches. The lower court allowed the injunction, but the supreme court reversed, stating that the appellee had reserved only the right to reasonably restrict appellant's use of a motorboat, and not the right to completely prohibit it. The court further found that the elements of nuisance alleged by appellee were speculative, and that no action for nuisance could lie without more definite proof. (Kelly-Fla)
W69-04895

STATE V NICHOLS (MISTAKE - FEDERAL AGENCY JURIS).
44 NW 2d 49-59 (Iowa 1950).

Descriptors: *Iowa, *Surveys, *Ownership of beds, *Federal jurisdiction, State jurisdiction, State governments, Federal government, Administrative agencies, Legal aspects, Judicial decisions, Islands, Boundaries (Property), Patents, Navigable waters, Non-navigable waters, Riparian rights, Meanders, Lakes, High water mark.

The State of Iowa brought suit in equity against defendant seeking vacation of a decree quieting title to the land in controversy. The land in question was an island which, because of mistake or inadvertance, was not described in a federal government survey of the lake made in 1852, when Iowa was a territory. Around 1900, the federal government resurveyed the lake, and upon discovery of the existence of the island, conveyed a patent thereof to the defendant's remote grantor. The State contended that the lake in question was a navigable body of water and that the property in question was a part of the bed of that lake. It was therefore alleged that title to the island passed to the state by virtue of its admission to the Union as a sovereign state. The court found that the lake was meandered and non-navigable, and that the plaintiff had failed to establish its title to the land. Since defendant's property was adjacent to a non-navigable lake, his title extended, under Iowa law, only to the ordinary high water mark. (Katz-Fla)
W69-04896

SCHMITT V KIRKPATRICK (DRAINAGE EASEMENT).
63 NW 2d 228-233 (Iowa 1954).

Descriptors: *Iowa, *Drainage water, *Overland flow, *Natural flow doctrine, Pipes, Tiles, Easements, Surface runoff, Ditches, Reasonable use, Judicial decisions, Legal aspects, Standing waters, Lakes, Farm ponds, Legislation, Precipitation excess, Relative rights.
Identifiers: Injunctions (Prohibitory).

Plaintiff sought to restrain an adjoining landowner from maintaining open ditches draining two ponds into a swale and thence onto plaintiff's land. The court held that the Iowa rule concerning drainage easements is that an upper proprietor may drain his land through natural watercourses in such a manner as to increase the flow over the servient estate, provided that such increase is not too great or in such unnatural quantities as to cause substantial injury. Plaintiff's evidence tended to show that the defendant was casting off excess water through an artificial, rather than a natural, watercourse but the court held that this fact alone was immaterial in view of the plaintiff's failure to allege and prove that he would be substantially damaged by the increased flowage. (Katz-Fla)
W69-04897

BENNETT V COUNTY OF EATON (CONCENTRATED DRAINAGE ONTO LOWER LANDS).

340 Mich 330, 65 NW 2d 794-798 (1954).

Descriptors: *Michigan, *Natural flow doctrine, *Surface drainage, *Culverts, Alteration of flow, Groundwater movement, Dispersion, Surface runoff, Flow, Precipitation excess, Excess water (Soils), Water rights, Legal aspects, Judicial decisions, Water law, Remedies, Damages, Diversion structures.

Plaintiff sought an injunction compelling removal of culverts across a road which ran adjacent to his land. It was alleged that these structures diverted water from its natural course, causing it to flow onto plaintiff's land in such amounts as to render a portion thereof unfit for farming. A surveyor's testimony supported the theory that surface water which would normally have drained onto plaintiff's land in a diffused state was artificially concentrated by the existing culverts. The court held that plaintiff was entitled to an injunction. Plaintiff, as owner of the lower estate, must receive the natural flow of surface water from the upper estate, but the owner of the upper estate cannot lawfully concentrate such flow, by means of an artificial drain, to the detriment of the lower owner. Highway commissioners have the right to drain surface waters which naturally flow onto a highway; such drainage may be through natural and usual channels upon and over lower lands. However, upland owners may not concentrate surface waters, which would naturally flow in a diffused state over a large area and cast them upon the lands of abutting owner to his damage without liability. (Gabrielson-Fla)
W69-04898

YOUNG V MOORE (LANDOWNERS RIGHT TO DRAIN EXCESS SURFACE WATER).
236 SW 2d 740-745 (Ct App Mo 1951).

Descriptors: *Missouri, *Surface waters, *Repulsion (Legal aspects), *Drainage, Surface runoff, Furrow drainage, Ditches, Wetlands, Judicial decisions, Water law, Excess water (Soils), Agricultural watersheds, Remedies, Legal aspects, Lakes, Bayous, Relative rights.
Identifiers: Injunctions (Prohibitory).

Plaintiff brought action to enjoin defendant from causing excess surface water to flow onto plaintiff's land. Plaintiff's land was situated 1/4 mile southwest of defendant's agricultural land. In 1948, defendant cleaned a drainage ditch on his property, which had been constructed 40 years previously, for the purpose of draining his land. The ditch followed the natural flow and emptied into a slough located wholly on defendant's land. The court held for defendant, basing its decision on the common enemy doctrine and construction of a state statute. The statute declared that, for agricultural purposes, a landowner was entitled to drain his land by constructing a drainage ditch on his property which would empty into a lake, bayou, etc. Procedures were also available to procure intervening lands for this purpose. The court stated that surface water was a common enemy and that a land proprietor may ward it off, even onto his neighbor's property, if he acts reasonably so as not to needlessly injure the servient tenements. Cleaning and widening, but not deepening, the ditch so as to drain an additional five acres of land was deemed reasonable by the court. (Holt-Fla)
W69-04899

CLARK V CITY OF SPRINGFIELD (NUISANCE ABATEMENT SEWAGE AND SURFACE WATER).

241 S W 2d 100-109 (Ct App Mo 1951).

Descriptors: *Missouri, *Pipes, *Surface runoff, *Rainwater, Drainage water, Surface waters, Sewage disposal, Sewage sludge, Sewers, Drainage systems, Waste water, Easements, Local governments, Nuisance (Water law), Operations, Judicial decisions, Legal aspects, Damage, Diversion structures, Ditches, Operation and Maintenance.

Plaintiff brought this action for damages alleged to have been caused by the overflow of surface and sewage waters onto and across his premises. The evidence indicated that plaintiff's property was directly in the path of the natural flow of surface water in the area but that the city had installed a storm drain channeling the surface runoff into a ditch running toward plaintiff's property and directly above the city's sanitary sewer line. The result of maintenance of these tandem ditches was to increase the pressure in the sewer pipes by the infiltration of surface water from the ditch. Consequently, in periods of even light rain, the sewage contained in the pipes would boil up, flow through manhole covers, and mix with the surface water which was running across plaintiff's premises. The court recognized the common enemy doctrine which allows an upland owner to divert water from his premises by casting it upon the land of another. The city was found to have artificially impounded the surface water and to have cast it upon the plaintiff's servient estate in a destructive manner, thus violating a recognized qualification of the doctrine. Accordingly, damages were awarded in favor of the plaintiff. (Katz-Fla)
W69-04900

SCAMP V STATE (ACTION FOR NEGLIGENT HIGHWAY CONSTRUCTION OBSTRUCTING NATURAL SURFACE WATER FLOW).
70 NYS 2d 752-758 (Ct Cl 1947).

Descriptors: *New York, *Relative rights, *Surface runoff, *Repulsion (Legal aspects), Alteration of flow, Road construction, Surface drainage, Surface water, Rainwater, Storms, Drainage effects, Culverts, Artificial watercourses, Judicial decisions, Drainage engineering, Streams, Drainage systems, Water law, Riddance (Legal aspects).

Plaintiff Scamp, a landowner, alleged negligent highway construction and failure to maintain drainage facilities in an action for damages against

the defendant. An obstructed culvert had caused water to accumulate on the highway and then flow across municipally owned land, which was graded toward claimants property, onto claimant's land. The court dismissed plaintiff's case for failure to sustain his burden of proof. Although it is true that when a plan of sewerage is effectuated by a municipal corporation the municipality is liable for damages resulting from either negligent construction or maintenance, the municipality is not, however, liable for an increase in surface water flow resulting solely from the grading of streets, erection of buildings, or improvements to private property. When, without the creation of a defined watercourse or the alteration of an existing one, the result is to change the natural contour of the land causing surface water to collect in a highway and overflow onto a neighbor's property, the act is lawful. Since it is not cast upon their lands by drains or ditches, the upper owners may get rid of it any way they can. (Kelly-Fla)
W69-04901

DIVELBISS V PHILLIPS PETROL CO (ACTION FOR DAMAGES TO DAIRY HERD BY STREAM POLLUTION).
272 SW 2d 839-845 (Ct App Mo 1954).

Descriptors: *Water pollution, *Oil wastes, *Missouri, Dairy industry, Contaminents, Judicial decisions, Legal aspects, Water pollution effects, Cattle, Pastures, Water pollution sources, Pollutant identification.

Plaintiff brought this action for damages to his dairy herd caused by defendant's pollution of a stream running through plaintiff's pastures. The appellate court upheld the jury's decision in favor of plaintiff on the ground that defendant had permitted petroleum products to pollute the stream, this constituting a private nuisance. It was unnecessary for plaintiff to allege or prove any negligence on the part of defendant. Plaintiff need only prove that defendant's pumping station was the source of the pollution. The court permitted damages for any of plaintiff's injuries which could be attributed to the polluted stream, including value of cattle which died, depreciation of value of the remaining cattle, and loss of profits. (Kelly-Fla)
W69-04902

PEOPLE V SYSTEM PROPERTIES (OWNERSHIP OF DAMSITE; STATE'S POWER TO CONTROL LAKE LEVEL).
160 NYS 2d 859-869 (1957).

Descriptors: *New York, *Damsites, *Ownership of beds, *Water levels, Judicial decisions, Backwater, Lakes, Navigable rivers, Flow control, Floods, Reservoirs, Impounded waters, Beds under water, Navigable waters, Riparian rights, Streambeds, Prescriptive rights.

The state and numerous intervening private owners brought suit to gain control of defendant's dam so as to regulate the water level of Lake George. This court modified and affirmed a lower court decision holding, inter alia, that defendant owned the bed at the damsite. In New York the bed of a stream is subject to private ownership regardless of its navigability. The defendant's earliest predecessor held a grant of lands, on both sides of the river, directly from the English Sovereign. Where there is no express inclusion or exclusion of the bed in a grant which touches the water, title extends to the middle of the river. The defendant has earned, by adverse possession of 160 years, the right to maintain a dam across the river. The state, however, has the power to regulate the use of the lake and river in the public interest. The defendant could never gain any prescriptive right over such control. Private owners along the lake and river may not now assert a right to prevent flooding caused by the dam, but the state legislature through its unimparied sovereignty may act to remedy the problem. (Blunt-Fla)
W69-04903

HARBORS, WHARVES AND HARBOR MASTERS.
Mich Comp Laws Ann secs 97.1-97.6 (1967).

Descriptors: *Michigan, *Cities, *Docks, *Harbors, Port authorities, Navigable waters, Levees, Piers, Boating regulations, Water pollution control, Legislation, Canals, Lake shores, Banks.
Identifiers: *Harbormaster, Safety regulations.

The council of any city located on any navigable waters shall have power to establish and control public wharves, levees, basins and canals upon any land under city control. Requirements for construction and material may be established for public or private landings. The council may lease privileges to lands or shore under city control, but for no longer than five years. The council is empowered to regulate use and rates and collect dockage on all public and private landings. City ordinances may provide for preservation of pure waters within the city and as far as 1/2 mile from the corporate boundaries. Violators of such ordinances may be punished. Regulations for safety of harbors, landings and navigable waters may be established by ordinance or through a harbormaster. (Harris-Fla)
W69-04904

RAILWAY COMPANIES, DRAINAGE REPAIRS: FAILURE, EXPENSE OF COMPANY.

Mich Comp Laws Ann sec 91.7 (1967).

Descriptors: *Michigan, *Railroads, *Right-of-way, *Surface drainages, Cities, Sewers, Culverts, Legislation, Local governments, Remedies, Controlled drainage, Water control.

The city council of an incorporated city shall have power to require any railroad or street railway company to make and keep in repair such drainage facilities as are necessary along, under and across their grounds and right of way to insure proper drainage. The council may also insure that the natural drainage of adjacent property is not impeded. If any such company neglects its duty according to the council requirements the council may cause the work to be done at the expense of the company. The amount expended may be collected by a suit of the city against the company. (Harris-Fla)
W69-04905

FOURTH CLASS CITIES - GENERAL POWERS OF CITY CORPORATIONS.
Mich Comp Laws Ann sec 91.1 (1967).

Descriptors: *Michigan, *Cities, *Water law, *Legislation, Permits, Harbors, Boating regulation, Boats, Bridges, Rates, Sewers, Cisterns, Drains, Pollution, Pumps, Hydrants, Reservoirs, Local governments.
Identifiers: *Tugboats, *Wharfboats, *Ferries, *Vaults, Bathing.

Every city incorporated as a fourth class city shall have general powers and authority, and may pass ordinances to license and regulate wharf boats and tugboats used in and about harbors within the city's jurisdiction; to authorize, license and regulate ferries and to regulate rates thereon; to regulate and license toll bridges and prescribe rates for passage; to regulate construction, repair and use of vaults, cisterns, areas, hydrants, pumps, sewers and gutters; to regulate bathing in waters of the city; to provide for the clearing of noxious matter from waters and to prevent pollution; to regulate construction of drains, sinks and privies; to establish and regulate public fountains and reservoirs. (Harris-Fla)
W69-04906

VANCE V DAVIS (ADJUDICATION OF WATER RIGHTS).

195 Va 730, 80 SE 2d 396-401 (1954).

Descriptors: *Clay pipes, *Pipe flow, *Virginia, Reservoirs, Hydraulic structures, Easements, Adjudication procedure, Legal aspects, Judicial decisions, Springs, Spring waters, Water sources, Usufructuary right, Water utilization, Water tanks, Domestic water.

A partition decree gave the owner of a portion of tract, knows as lot 2, the right to use and draw spring water from another portion of the tract, known as lot 4. The residence of two new families on lot 4 has created a water shortage, and the appellee contends that the commissioner creating the easement in question intended for the appellee to have use of all the water from the spring, to the exclusion of all others, as may be necessary for his domestic needs. The court examined the language in the appellee's deed and determined that the original grantee of tract 4 was entitled to share equally in the spring water. The two new families, having taken from that grantee, were entitled to share in the spring flow in such a manner as not to restrict the appellee's supply. The appellee was found to be entitled only to that water strictly necessary for domestic needs and was required to install spigots to prevent waste. (Katz-Fla)
W69-04907

HOLLAND V FT PIERCE FINANCING AND CONSTR CO (ACTION TO SEIZE LANDFILL CONSTRUCTED IN NAVIGABLE STREAM).
27 So 2d 76-83 (Fla 1956).

Descriptors: *Navigable waters, *Landfills, *Riparian rights, *Florida, High water mark, Submerged lands, Judicial decisions, Legal aspects, Dredging, Channels, Channel improvement, Bulkheads, Bays, Harbors, Land reclamation, Sand bars, Navigation.

Appellant, Holland, representing the state, alleged that appellee construction company had illegally filled in and bulkheaded part of a navigable stream, and that appellee had no title to the filled land. The Florida Supreme Court found, however, that appellee was acting within the provisions of Florida law. Florida statue 271.01 (1945) vests qualified title in riparian owners to land beneath navigable streams from the high water mark to the beginning of the channel. Title becomes absolute when the riparian owner fills in the area and erects improvements. Appellee's improvements were beneficial and did not obstruct commerce or navigation. The court held a later special act passed by the Florida legislature unconstitutional in that it attempted specifically to seize appellee's property for the state after the requisite improvements had been made. (Kelly-Fla)
W69-04908

LABRUZZO V ATLANTIC DREDGING AND CONST CO (ACTION TO RECOVER DAMAGES FOR DISRUPTION OF UNDERGROUND STREAM).
54 So 2d 673-678 (Fla 1951).

Descriptors: *Obstruction to flow, *Relative rights, *Underground streams, *Florida, Percolating water, Groundwater movements, Excavation, Springs, Water flow, Reasonable use, Diversion, Groundwater barriers, Judicial decisions, Legal aspects, Competing uses, Water rights, Water law.

Plaintiff brought this action for damages, alleging that defendant, while conducting excavation operations on its property, had permanently diverted and disrupted an underground stream that flowed beneath defendant's property to plaintiff's property, where it erupted as a spring. The court stated that although defendant's operation did not constitute a competing use of the water from the underground stream, his use of the land incidentally affected the stream, creating a duty of care. The court held that in the absence of surface indications an interference with subterranean water is considered unintentional and is non-actionable. If defendant knew his actions might permanently disrupt plaintiff's water supply, however, liability

could be found for megligence. The court noted a plaintiff's allegation that defendent discovered the underground stream in time to prevent permanent damage but proceeded with his excavation. According to the court, evidence supporting this allegation created a question for a jury, and plaintiff's complaint was improperly dismissed. (Kelly-Fla)
W69-04909

LABRUZZO V ATLANTIC DREDGING CONSTRUCTION CO (EXCAVATION DIVERTING UNDERGROUND WATERS).
73 So 2d 228-231 (Fla 1954).

Descriptors: *Florida, *Springs, *Rock excavation, *Alteration of flow, Diversion, Underground streams, Subsurface waters, Water rights, Damages.
Identifiers: *Stoppage, Capping.

Plaintiffs brought action for damages for allegedly interrupting and diverting the natural flow of underground waters that fed plaintiffs' spring. Plaintiffs, were owners of land on which there formerly erupted a spring, and its water was bottled and sold by them. Defendant's land was contiguous thereto; and during course of excavation work undertaken by defendant the subterranean stream which supplied plaintiffs' spring was uncovered and the flow from the spring ceased. Evidence on issue of whether defendant was negligent in respect to pouring concrete into crevice which had been opened by excavation on defendant's land and through which water had been diverted from plaintiffs' spring did not justify jury's finding for defendant and case was reversed and remanded for new trial. Defendant's potential liability was said to be based on its responsibility for an intentional invasion of palintiffs' water rights if its conduct was in fact unreasonable considering all the circumstances. (Reed-Fla)
W69-04910

MONTGOMERY LIMESTONE CO V BEARDEN (ACTION TO ENJOIN POLLUTION OF A STREAM BY QUARRY OPERATION).

54 So 2d 571-575 (Ala 1951).

Descriptors: *Water pollution, *Pollution abatement, *Riparian rights, *Alabama, Judicial decisions, Legal aspects, Water pollution effects, Public benefits, Quarries, Natural flow, Livestock, Cattle, Channels, Streams, Pollutants, Water pollution sources, Air pollution.

Appellee, Bearden, sued to collect damages and to enjoin appellant from conducting quarry operations which, according to appellee, resulted in heavy pollution of a stream flowing onto appellee's property from appellant's property. Appellee specifically claimed that appellant was discharging such quantities of sludge, rock, limestone, and other impurities into the stream as to render it unfit for consumption by appellee's cattle and livestock. The court stated that in deciding whether injunctive relief for water pollution was warranted, it must balance the private injury suffered by appellee with the public benefit to be derived from appellant's operation. The pollution must be considerable, not just a minor annoyance or inconvenience, before equity will act. The court found that appellant's quarry operation resulted in substantial impairment of the value of the stream to downstream riparian owners, that the pollution resulting from the operation went beyond the permissible scope of public benefit, and that appellee had stated a good cause of action. (Kelly-Fla)
W69-04911

BURKHARDT V ROCKY (DEPOSIT OF DEBRIS IN STREAMS - OVERFLOW).
79 D and C 271-275 (Com Pl 1949).

Descriptors: *Pennsylvania, *Streamflow, *Obstruction to flow, *Floods, Land tenure, Judicial decisions, Diversion, Relative rights, Legal aspects, Damages, Backwater.
Identifiers: *Acts of God, *Natural disasters, *Trespass, Proximate cause, Debris.

Plaintiff and defendant own adjacent tracts of land. A stream ran through defendant's property very near the boundary of plaintiff's land. A tenant of defendant moved brush, dirt, and other debris into the bed of the creek. Plaintiff advised the defendant of this fact, and defendant agreed to remedy the situation. Before the debris was removed, a heavy rainfall occurred, and the debris dammed the creek causing damage to plaintiff's property. Such an overflow had never occurred under similar circumstances. Plaintiff seeks damages. A jury verdict for plaintiff was had below. The court held it was for the jury to determine whether the defendant was liable or whether the injury was due to an act of God. The verdict below was fully sustained by the weight of the testimony, and defendant's motion for new trial and judgment not withstanding the verdict were refused. (Harris-Fla)
W69-04912

CONGDON V PIONEER CITY COAL CO (RAINWATER RUNOFF).

56 Lackawanna Jurist 9-12 (Com Pl 1952).

Descriptors: *Surface drainage, *Groundwater movement, *Natural flow, *Alteration of flow, Easements, Judicial decisions, Legal aspects, Rainfall disposition, Precipitation excess, Surface runoff.
Identifiers: *Lower land owners, Upland owners.

Plaintiff owned land adjacent to and lower than the land of defendant coal company. During certain seasons, water from heavy rains was permitted to run onto plaintiff's property. Plaintiff claimed injury to the land and his dwelling house and sought a restraining order and damages. The court held that the owner of high-level land has a right to have water flow from his land and be discharged in a natural watercourse upon lower, adjacent land. He may not make new channels or concentrate or increase the flow by artificial means. To this extent, the upper owner possesses an easement to discharge all water which rises in, flows over, or falls on the higher ground. (Harris-Fla)
W69-04913

SPARTAN DRILLING CO V BULL (INJUNCTION TO CURE SALT WATER POLLUTION AND INSECT BREEDING).

252 SW 2d 408-411 (Ark 1952).

Descriptors: *Remedies, *Arkansas, *Water pollution, *Mosquitoes, Judicial decisions, Saline water, Riparian rights, Oil wells, Brine disposal, Administrative agencies, Streams, Legal aspects, Damages, Riparian land.
Identifiers: Injunction (Mandatory), Injunction (Prohibitory), Jurisdiction.

Several oil wells produced salt water which was allowed to escape into area streams and creeks. The subsequent pollution caused the breeding of large quantities of salt water mosquitoes. Thirteen home owners filed suit to restrain the owners and operators of the wells from creating a condition which rendered it impossible for them to enjoy their property. The chancellor overruled a demurrer and permanently restrained the owners from permitting salt to escape into the creeks. A prayer for a mandatory injunction to clean the polluted area was denied. The well owners appealed. The supreme court held that every man must use his property so as not to injure that of his neighbor. Riparian owners harmed by another's use or misuse of his property may obtain an injunction to prevent such abusive practices even though the defendant is thereby put to expense. Pollution which causes detrimental breeding of mosquitoes constitutes a nuisance which may be attacked without exhausting administrative remedies. The order of the lower court was affirmed. (Harris-Fla)
W69-04914

W G DUNCAN COAL CO V JONES (PRESCRIPTIVE RIGHTS TO MINEWATER POLLUTION).

254 SW 2d 720-724 (Ky 1953).

Descriptors: *Kentucky, *Mine water, *Water pollution, *Prescriptive rights, Coal mine wastes, Riparian rights, Judicial decisions, Crops, Water injury, Overflow, Legal aspects, Damages, Pollutants, Streams.
Identifiers: *Private nuisance, *Public nuisance, *Trespass.

Plaintiff brought action to recover for crop damage allegedly caused by deposit of mine water in a stream. The circut court rendered judgment for plaintiff. The defendant mining company had discharged mine water into a stream since 1920. The stream overflowed onto plaintiff's land, and the mine water poisoned his crops. The defendant argued on appeal that it had obtained a 'prescriptive right' to discharge into the stream through its long and continued use. The court of appeals held that since the nuisance complained of is only a private nuisance, if defendant had used the stream for the statutory 15 year period for the same purpose, to the same extent, and under the same circumstances, it had acquired a prescriptive right. If any change in nature or volume of the discharged mine water is proved, the prescriptive rights may not be available. Reversed for further proceedings. (Harris-Fla)
W69-04915

DE VORE FARMS V BUTLER HUNTING CLUB (DAMS AND OBSTRUCTION TO FLOW).

286 SW 2d 491-494 (Ark 1956).

Descriptors: *Arkansas, *Obstruction to flow, *Reasonable use, *Natural flow doctrine, Dams, Spillways, Riparian rights, Bayous, Non-navigable waters, Streams, Lumber, Judicial decisions, Damages, Flood damage, Flooding, Relative rights, Legal aspects.
Identifiers: Injunctions (Mandatory).

One riparian owner brought suit against another to restrain the maintenance of a dam and to collect damages for injury to timber due to flooding. Defendant hunting club maintained a dam which plaintiff claimed caused an obstruction to the natural drainage of his land. Plaintiff alleged that by blocking Mill Bayou, a shallow, non-navigable stream, the defendant had rendered plaintiff's land valueless for purposes of growing timber. Plaintiff also asked $20,000 in damages for merchantable timber already destroyed by flooding allegedly caused by the dam. The chancery court dismissed plaintiff's complaint. The Supreme Court of Arkansas affirmed, holding that, under the 'natural flow' or 'reasonable use' doctrines, it was well settled that one riparian owner had no right to interfere with the flow of a stream to the detriment of another. The question whether an obstruction is detrimental is purely one of fact, and a preponderance of the evidence had not proved appellant's case. (Harris-Fla)
W69-04916

LARSON V REMEIKIS (ACCELERATION AND DIVERSION OF NATURAL DRAINAGE RELATIVE RIGHTS).

76 NE 2d 922-924 (Ct App Ohio).

Descriptors: *Ohio, *Drainage ditches, *Natural flow, *Diversion, Damages, Judicial decisions, Erosion, Land Tenure, Boundaries, Groundwater movement, Legal aspects, Surface drainage, Surface runoff.

Identifiers: *Acceleration of flow, *Adjacent land, *Upper landowner, *Lower landowner, Injunction (Prohibitory).

Plaintiff and defendant owned adjoining farms. Plaintiff's land was higher than defendants', and normal drainage of surface waters was over defendants' land. Defendant constructed a ditch along the boundary which accelerated and diverted the water back onto plaintiff's land, damaging his fence and causing injury to cattle which fell into the ditch. The court below entered a permanent restraining order against trespass by defendant and awarded damages for injury to the cattle and the fence. Defendant appealed. The court of appeals held that where two parcels of land lie adjacent to each other, and one lies lower than the other, the lower land is burdened with a servitude in favor of the upper tract to receive water which naturally runs from such tract, provided the industry of man has not created the servitude. A mere acceleration of natural flow by the owner of upper land is not actionable. However, acceleration plus diversion will give rise to a cause of action. Damages for injury to cattle and boundary fences are collectable when the injury is caused by an acceleration and diversion by a ditch. A mandatory injunction may also issue to restrain further trespass and to compel restoration of surface land to its original condition. (Harris-Fla)
W69-04917

THE POLITICS OF WATER IN ARIZONA,
Arizona Univ., Tucson.
Dean E. Mann.
University of Arizona Press,, 1963, 288 pp, 5 map, 37 illus, 1 tab, abt 720 ref.

Descriptors: *Water supply, *Political aspects, *Planning, *Arizona, Federal government, State government, Legislation, Legal aspects, Electric power, Land management, Conservation, Research facilities, Geological surveys, Inter-agency cooperation.
Identifiers: U.S. Department of Agriculture.

Arizona faces a water crisis. Surface and stored waters are fully exploited. Costs of pumping underground water are fast becoming prohibitive. Urban areas are experiencing water shortages or diverting water from agricultural use. Mann begins by describing Arizona physically. He then discusses national and state political issues affecting water resources. The discussion includes: contemporary water resources planning; surface water law; ground water law; the politics of water; political and legal issues in the Colorado River controversy; the problem of electric power and governmental responsibilities; state management of water resources; federal activities in water management; governmental deficiencies in land management; soil and water conservation services; necessary management for recreation and conservation benefits; the divisions between the practices of agencies carrying on water research; research at the University of Arizona; work of the U.S. Geological Survey; the activities of and cooperation between various agencies of the U.S. Department of Agriculture. Rather than allocate water to the highest bidder in the economics of the market place, Mann recommends a change in governmental policy on resources. Public agencies must recognize some leadership that focuses attention and develops programs which take into account all factors of interrelated resources. (Gossen-Chicago)
W69-05112

THE WATER CRISIS,
For primary bibliographic entry see Field 06B.
W69-05113

WATER TRANSFER PROBLEMS: LAW,
New Mexico Univ., Albuquerque.
For primary bibliographic entry see Field 06B.
W69-05117

POLICY PROBLEMS IN THE FIELD OF WATER RESOURCES,
Resources for the Future, Inc., Washington, D. C.
For primary bibliographic entry see Field 06B.
W69-05119

CURRENT TRENDS IN WISCONSIN'S WATER LAW,
Wisconsin State Bar, Madison.
J. H. Beuscher.
Wis B Bul, Vol 40, No 4, pp 19-28, April 1967. 10 p.

Descriptors: *Wisconsin, *Surface runoff, *Riparian rights, *Repulsion, Judicial decisions, Surface drainage, Municipal water, Avulsion, Accretion, Legislation, Relative rights, Well permits, Public rights, Irrigation permits, Water quality standards, Administrative agencies, Pollution abatement.
Identifiers: *Absolute property doctrine, *Source of title test, *Co-sharing of riparian rights, Water Resources Act of 1966, Subsidies.

Water Law is divided into three parts: (1) the law of draining 'diffused' surface water; (2) the law of groundwater; and (3) riparian law, which applies to streams, lakes, and ponds. So far there has been no Wisconsin case law about ownership of and right to use captured diffused surface waters. The Wisconsin court has applied the Massachusetts common enemy rule of diffused surface water law. As to groundwater law, Wisconsin still holds to the absolute property doctrine and has refused to shift to the 'reasonable use' or American rule. Except for section 144.025, which requires a permit for wells with a capacity in excess of 100,000 gallons a day, no legislation regulating withdrawal of groundwater exists. As to the law of water in streams, lakes, and ponds, the Wisconsin court has played a principal part in declaring co-sharing of riparian rights and in delineating public rights in navigable water on behalf of non-riparians. The major recent development in the field has been the Water Resources Act of 1966 (Chapter 614, Laws of 1965-66), which united in the Department of Resource Development all water regulatory responsibilities. (Reed-Fla)
W69-05161

BROWARD COUNTY V HURWIT (MUNICIPAL WATER AND SEWER FACILITIES).

216 So 2d 225-227 (4th DCA Fla 1968).

Descriptors: *Florida, *Judicial decisions, *Utilities, *Water supply, Sewage districts, Public utilities, Water distribution (Applied), Water sources, Cities, Local governments, Sewerage, Water management (Applied).

In 1960, the City of Lauderhill granted a franchise to defendant county's predecessor to operate water and sewer facilities within the city limits. In 1963 when the franchise was assigned to defendant, the city limits did not extend to the area in question but defendant did hold certificates of public convenience and necessity for an adjacent area. In 1962, plaintiff acquired the assets of a water company and certificates for the area in question by an issuance of bonds and a pledge of the expected revenue. The certificates were cancelled by the public utilities commission. The plaintiff had no facilities located on the property when it was incorporated into the city limits in 1965. The court held that plaintiff had no right to operate a water and sewer system in the area. The Florida statutes provide that the consent of the city is necessary unless the facilities were located in the area prior to its incorporation into the city. Plaintiff's contract was not impaired in that no revenues pledged to the payment of the bonds have been diverted. (Molica-Fla)
W69-05162

NICHOLSON V HOLLOWAY PRINTING CO (ARTIFICIAL INCREASE OF SURFACE RUNOFF).
216 So 2d 562-576 (Ct App La 1968).

Descriptors: *Louisiana, *Surface runoff, *Natural flow, *Drainage, Judicial decisions, Surface drainage, Ditches, Drainage water, Topography, Bayous, Gulf coastal plain, Deltas, Coastal plains, Developed waters, Relative rights, Obstruction to flow, Alteration of flow, Repulsion (Legal aspects), Legal aspects, Riddance (Legal aspects).
Identifiers: Dominant estates, Servient estates.

Plaintiff sought affirmation of a right to drain waters from his upper estate over the defendants land through natural 'crevasse channels.' Defendant contended that his land was not 'below' the plaintiff's, and therefore no drainage servitude existed. The trial court found that defendant's land was of the same elevation as the plaintiff's and dismissed the plaintiff's petition. This court affirmed the lower court on other grounds. Even though the plaintiff's land was of higher elevation, the basin areas he wished to drain could not be emptied through the natural channels without installation of extensive artificial facilities. The servient owner has a duty to maintain all natural channels so that they will receive water from the upper estate, but the upper owner may not improve his estate by artificial means so as to add to the natural runoff and make the obligation of the servient estate more onerous. (R. Blunt-Fla)
W69-05163

WILSON V OWEN (EASEMENT - USE OF LAKE).

261 SW 2d 19-26 (Mo 1953).

Descriptors: *Missouri, *Reasonable use, *Lakes, *Easements, Recreation facilities, Public benefits, Riparian lands, Riparian rights, Real property, Water rights, Prescriptive rights, Relative rights, Judicial decisions, Legal aspects, Adjudication procedure, Remedies, Contracts, Swimming, Boating, Fishing.
Identifiers: Advertisements, Restrictive covenants.

The plaintiff appellee brought this action for a declaratory judgment. He asked the court to recognize the cancellation of a restrictive covenant running with certain realty. The deed conveying the property had a reserved power of termination as to covenants, restrictions and stipulations. The alleged restriction provided that purchasers of the property would have the privilege of using lakes on the land for swimming, boating, and fishing purposes. An advertisement announcing the sale of the property stated that these privileges would run with the land and would be for the exclusive use of the purchasers. The court held that the alleged restriction was actually an affirmative easement and a privilege which was outside the reserved power of termination under consideration. (Katz-Fla)
W69-05164

GAGNON V CARRIER (ABANDONMENT OF EASEMENT FOR WATER SUPPLY).

77 A 2d 868-870 (N H 1951).

Descriptors: *New Hampshire, *Easements, *Water supply, *Recreation, Judicial decisions, Adjudication procedure, Legal aspects, Lakes, Right-of-way, Access routes, Pipes, Pumps, Water supply, Relative rights.
Identifiers: Equity.

Plaintiffs brought a bill in equity to determine the rights of the defendants in and over plaintiffs land with respect to right of way to a lake, and a right to use, repair, and maintain pipes and a pump house near the lake for water supply. The trial court held that the defendants had no right of way to the lake for recreational purposes, and that the easement they had for water supply had been abandoned. The Supreme Court of New Hampshire affirmed the lower court as to its ruling that an easement for water supply does not give a right to access for recreation, but it reversed the lower court's decision that the easement for water supply had been abandoned. The court stated that mere non-use of

an easement, however acquired, does not result in its loss or destruction even if continued for a long time. The court felt that the non-use of the easement for four years was not such a clear, unequivocal and decisive act as to constitute abandonment of the easement. (Watson-Fla)
W69-05165

PERSON V ROANE (RIGHT TO USE OF DRAINAGE DITCH ON ANOTHER'S PROPERTY).

67 So 2d 534-536 (Miss 1953).

Descriptors: *Mississippi, *Easements, *Drainage, *Ditches, Judicial decisions, Adjudication procedure, Legal aspects, Drains, Surface runoff, Surface drainage, Damages, Obstruction to flow, Prescriptive rights, Land ownership, Land tenure.
Identifiers: Equity, Injunction.

Plaintiff brought this action against an adjoining landowner for damages for entering on the plaintiff's land and setting off explosives, and for an injunction to restrain further trespasses. The defendant entered a cross-bill for an injunction to restrain the plaintiff from obstructing a drainage ditch. The trial court granted the plaintiff's injunction and dismissed the defendant's cross-bill. The Supreme Court of Mississippi held that the decision of the chancellor, who viewed the premises, was supported by the evidence. Damages were not awarded because the plaintiff had not been injured. Evidence showed that the use of the ditch by the defendant and his predecessor was with the permission of the plaintiff and not under adverse claim. Since the plaintiff had maintained his dominion over the ditch while allowing the defendants to use it, no easement had been acquired. (Watson-Fla)
W69-05166

OWENS V FAYETTE COUNTY (DRAINAGE NUISANCE ABATEMENT).

40 NW 2d 602-607 (Iowa 1950).

Descriptors: *Iowa, *Roadbed, *Diversion dams, *Repulsion (Legal aspects), Culverts, Riddance (Legal aspects), Ditches, Drainage systems, Legislation, Hydraulic structures, Embankments, Erosion control, Overland flow, Runoff, Surface waters, Judicial decisions, Legal aspects, Relative rights, Damages, Obstruction to flow.
Identifiers: Injunctions (Prohibitory), Servient estates, Dominant estates.

Plaintiff brought suit for damages and to enjoin defendants from causing damage to plaintiff's lands by wrongfully concentrating water flowing from dominant lands. The trial court issued the injunction and ordered removal of the culverts and dams allegedly causing the concentrated flow. The reviewing court found that the plaintiff's lands were servient as to drainage from the lands now separated by the raised highway. The court held that the evidence indicated that the county, an upper proprietor, had diverted the water in such a manner as to follow the natural drainage pattern and that no evidence was introduced to show accumulation and concentration in amounts greater than the natural rate of flow. (Katz-Fla)
W69-05167

MCCULLOUGH V HARTPENCE (DIVERSION OF DIFFUSED SURFACE WATER).

58 A 2d 233-235 (Ch N J 1948).

Descriptors: *New Jersey, *Repulsion, *Natural flow doctrine, *Surface runoff, Rain water, Drainage water, Natural flow, Encroachment, Equitable apportionment, Surface water, Diversion.
Identifiers: Capstones, Injunction.

Plaintiff brought suit to require defendants to remove an encroachment upon plaintiff's realty and defendants counterclaimed. The parties were owners of contiguous residential properties upon which they had each erected a garage near the dividing line of their properties. A capstone on the top wall of defendants' garage, which was above a like capstone on complainant's garage, caused rainwater falling on defendants' capstone to discharge on complainant's capstone where by reason of a counter incline, the water was directed against defendants' wall from which a quantity rebounded against complainant's wall. Under the common law, 'surface waters,' which embraces waters derived from falling rain is regarded as a common enemy that every proprietor is privileged to resist to the best of his ability, provided he does not alter the natural discharge of surface water from his land onto that of his neighbor. In addition, the pleadings alleged that each capstone overreaches the property line, and the proofs sustain the verity of both contentions. Therefore, the court directed both parties to remove the capstone for which they were respectively responsible. (Reed-Fla)
W69-05168

F A BARTLETT TREE EXPERT CO V STAMPER (DAMAGES FROM LOGS AND BRUSH ON RIVER BANK).

306 Ky 311, 207 SW 2d 752-755 (1948).

Descriptors: *Kentucky, *Brush, *Bridges, *Water pollution, Trees, Judicial decisions, Adjudication procedure, Legal aspects, Streamflow, Streams, Banks, Rain, Crops, Damages, High water mark, Lumber, Precipitation excess, Riparian rights, Rainfall.
Identifiers: Negligence.

Plaintiff brought an action against the defendant company for leaving trees and debris piled on a streambank in a negligent manner. The trees and debris washed downstream injuring the plaintiff's bridge, crops and lumber. In a jury trial the lower court held in favor of the plaintiff. The Court of Appeals of Kentucky reversed and remanded the case but only as to the amount of damages. The Court of Appeals stated that question of negligence in placing the trees and brush on the streambank was a jury question and it would not attempt to disturb the decision of the jury. (Watson-Fla)
W69-05169

FONTENOT V SMITH (CONTRACT AGREEMENTS AND RIGHTS TO NATURAL FLOW).

37 So 2d 872-874 (La Ct App 1948).

Descriptors: *Louisiana, *Natural flow doctrine, *Contracts, *Obstruction to flow, Legal aspects, Relative rights, Levees, Embankments, Canals, Surface drainage, Ditches, Spoil banks, Judicial decisions, Backwater, Floods, Remedies, Drainage, Engineering structures, Drainage engineering, Excessive precipitation, Rainfall excess, Surface runoff, Easements.
Identifiers: *Spoil dirt, *Injunction.

Plaintiff brought this action to require removal of an embankment. Plaintiff sold defendant an adjacent tract of land, and contracted for a mutual drainage ditch on the boundary of their lands. The ditch, to be maintained by defendant, was to adequately drain plaintiff's land. A ditch was dug which proved unsatisfactory. Both plaintiff and defendant made arrangements for drainage of their lands, with defendant digging a canal and depositing spoil dirt in an embankment facing plaintiff's land. The embankment caused water to back up on plaintiff's land during hard rains. The defendant contended that the agreement replaced the normal rights of servitude of drain, and made the ditch plaintiff's only enforceable method of drainage. Affirming a judgment for the plaintiff, the court of appeal held that the individual activities of the parties evidenced a return to the original status of natural drainage rights. As a result, defendant's land owned a servitude to plaintiff's to receive natural drainage not concentrated by man's industry. The court held that even if the agreement was not abrogated by individual action, defendant had no right to obstruct natural drainage. (Harris-Fla)
W69-05170

MCCORMICK COAL CO V R R SCHUBERT (NATURAL FLOW AND DIVERSION OF STREAM BED).

379 Pa 309, 108 A 2d 723-725 (1954).

Descriptors: *Pennsylvania, *Surface drainage, *Diversion, *Natural flow doctrine, Strip mining, Relative rights, Legal aspects, Judicial decisions, Natural streams, Streambeds, Floods, Damages, Alteration of flow, Coal mines, Drainage, Mining engineering, Mineral industry, Streamflow.
Identifiers: *Concentration of flow, *Coursing.

Plaintiff mining company filed suit to recover for damages allegedly caused by defendants' negligence in its strip mining operations. Plaintiff operated a coal mine which sloped from its opening downward to certain coal deposits purchased by plaintiff. Defendant was engaged in strip mining on land separated from plaintiff's mine by a tract of land on which old abandoned workings remained. Defendant's operations included changing the bed of a stream on its property and cutting into the old openings on the intervening land. Plaintiff alleges defendant was negligent in diverting the stream and in failing to seal the old openings. Plaintiff claims rain water which would have been drained off by the old stream ran through the old workings and finally into his mine, making it unworkable. In affirming a judgment for defendant and denying plaintiff's motion for a new trial, the Supreme Court of Pennsylvania stated that an upper owner has a right of natural flowage, but may not by artificial means increase or concentrate the flow to another's detriment. A change in the course of the stream or diversion of water from its ordinary course would result in strict liability. (Affirmed on a procedural point). Plaintiff failed to plead the latter liability. (Harris-Fla)
W69-05171

LUNSFORD V STEWART (COMMON ENEMY DOCTRINE).

120 NE 2d 136-137 (Ohio Ct App 1953).

Descriptors: *Ohio, *Repulsion (Legal aspects), *Riddance (Legal aspects), *Diversion, Easements, Runoff, Precipitation excess, Surface runoff, Drainage water, Overland flow, Natural flow doctrine, Obstruction to flow, Surface waters, Relative rights, Reasonable use, Alteration of flow, Legal aspects, Judicial decisions, Remedies, Damages, Water law.
Identifiers: Common enemy doctrine.

The plaintiff brought action for an injunction and damages because defendants had filled their lot with dirt up to grade and thus prevented surface water from draining off of plaintiff's adjoining lot. The court held that the owner of an urban lot which receives the natural flow of surface water from an adjoining upper lot, may divert the natural flow of such surface water by filling his lot and erecting structures on it; this could be done without liability for blocking such natural flow provided that such erecting and filling was accomplished in a reasonable manner. (Katz-Fla)
W69-05172

HODGES MANOR CORP V MAYFLOWER PARK CORP (DAMAGE DUE TO DISCHARGE OF SURFACE WATERS THROUGH ARTIFICIAL CHANNELS).

197 Va 344, 89 SE 2d 59-63 (1955).

Descriptors: *Virginia, *Flow augmentation, *Riddance (Legal aspects), *Drainage systems, Water law, Judicial decisions, Damages, Pipes, Surface runoff, Outlets, Overlying proprietor, Alteration of flow, Surface drainage, Surface waters, Property values, Routing, Discharge (Waters), Repulsion (Legal aspects), Legal aspects.

Defendant installed a drainage system with pipes which collected and discharged a concentrated flow of surface waters onto plaintiff's land. Defendant also lowered a ditch on plaintiff's land to permit an unobstructed flow of drainage water. Plaintiff sued for damages to residential property. The trial court awarded damages, allowing the jury to consider diminution of land value and the cost of a drainage system necessary to correct the situation. The award was commensurate with the correction costs. The appellate court affirmed, following the Virginia modification of the common-enemy rule. Landowners may discharge surface waters as they see fit, though not wantonly, unnecessarily, or carelessly. However, one must use his own property so as not to injure the rights of another. The court recognized an exception to the general rule, holding that owners may not collect water into artificial channels and subsequently discharge it upon land of another to his injury. (Wheeler-Fla)
W69-05173

REDDMANN V REDDMANN (OBSTRUCTION TO SURFACE WATER FLOW).
255 SW 2d 668-670 (Ark 1953).

Descriptors: *Arkansas, *Repulsion (Legal aspects), *Surface waters, *Obstruction to flow, Backwater, Surface runoff, Flood water, Flood damage, Relative rights, Water law, Overlying proprietor, Surface drainage, Levees, Rain water, Watercourses (Legal), Judicial decisions, Legal aspects, Damages.
Identifiers: Injunctions (Mandatory), Injunctions (Prohibitory).

Plaintiff alleged that defendants had wrongfully constructed levees which blocked natural drainage, and prayed for a mandatory injunction requiring removal of the obstructions. The chancellor decreed that there had been no stoppage of natural drainage by defendants. The appellate court held that evidence was insufficient to establish a well-defined watercourse over or through defendants' property and affirmed the decisions below. Overflow water from a watercourse is flood or surface water, and it is not the duty of a landowner to provide a means by which flood water may be carried over and across his land. A landowner has the right to defendant against this 'common enemy' without subjecting himself to liability for damages unless he unnecessarily damages another for his own protection. (Wheeler-Fla)
W69-05174

CONDIFF V KOPSEIKER (EASEMENT - SURFACE DRAINAGE).

61 NW 2d 443-446 (Iowa 1953).

Descriptors: *Iowa, *Repulsion (Legal aspects), Riddance (Legal aspects), Surface waters, Drainage water, Surface runoff, Pipes, Ditches, Drainage systems, Hydraulic structures, Legal aspects, Judicial decisions, Legislation, Easements, Tile drains.
Identifiers: Demurrer.

Plaintiffs sought to enjoin the discharge of water from defendant's lands onto plaintiff's land in a greater volume than before installation of a tile drain system on defendant's land. The court noted that upper proprietors may drain their land by constructing open or covered drains discharging in the same manner as a natural watercourse. Absent allegations that additional water was made to flow upon plaintiff's land by reason of the drainage system and that such increased flow caused damage, the plaintiff had failed to state a cause of action. (Katz-Fla)
W69-05175

MUSGROVE V CICCO (MAINTENANCE OF WHARF OVER OBJECTION OF LITTORAL OWNER).

71 A 2d 495-496 (N H 1950).

Descriptors: *New Hampshire, *Riparian land, *Competing uses, *Riparian rights, Ownership of beds, Prescriptive rights, Relative rights, Piers, Lake beds, Public rights, High water mark, Nonconsumptive use.
Identifiers: *State property.

Plaintiffs brought suit to recover damages for defendant's use and occupation of a bathing beach on a lake. The trial court issued judgment for plaintiffs; and on appeal, this court overruled defendant's exceptions. It was held that plaintiffs, as littoral owners, had rights which were more extensive than those of one who was only a member of the public. While the bed of the lake was the property of the state to the natural high water mark, plaintiffs' rights to erect a wharf or other structure into the lake was superior to that of defendants', hotel owners in the vicinity, if the latter had only the rights of a member of the public. Thus, defendants had no right to maintain a wharf over the objection of plaintiffs, in the absence of a prescriptive right or an express grant from the public. (Reed-Fla)
W69-05176

ROBINSON V BELANGER (SURFACE WATER DRAINAGE RIGHTS).
For primary bibliographic entry see Field 04A.
W69-05177

WATTERS V NATIONAL DRIVE-IN (SURFACE WATER DRAINAGE DAMAGE).

63 NW 2d 708-711 (1954).

Descriptors: *Repulsion (Legal aspects), *Wisconsin, *Drainage systems, *Surface runoff, Overlying proprietor, Relative rights, Judicial decisions, Water law, Tile drains, Sewage, Drainage effects, Damages, Effluents, Surface waters, Alteration of flow, Drainage, Drainage water, Surface drainage, Riddance (Legal aspects), Rain water, Legal aspects.

Plaintiffs brought action against an adjacent upper land owner for damages resulting from drainage of surface waters and sewage onto plaintiffs' land. On appeal of order overruling defendant's demurrer, the appellate court held that plaintiffs had no cause of action based on either defendant's installation of tile drains or alteration of the natural flow of surface waters. The court followed the common enemy rule, holding that defendant could drain surface water any way he saw fit, regardless of injury to lower land, as long as the water was not collected first in a reservoir. The case was remanded in order to determine whether plaintiff had a cause of action due to the alleged sewage discharge. (Wheeler-Fla)
W69-05178

RUTHERFORD V LOUISVILLE AND NASHVILLE RR (FLOODING FROM OVERFLOWED CULVERT).
243 S W 2d 1017-1019 (Ky 1951).

Descriptors: *Kentucky, *Surface runoff, *Flood damage, Reasonable use, Relative rights, Diversion, Ditches, Culverts, Overflow, Right-of-way, Natural flow, Surface water, Surface drainage, Water law, Legal aspects.
Identifiers: *Upper estate, *Lower estate.

Plaintiffs sued railroad and individual defendant for damages caused by water overflowing their lands after passing through a drainage ditch constructed by the latter. Since the individual defendant's part of the ditch was constructed by him prior to the time plaintiffs bought their properties, and since there was no evidence he and the railroad acted in concert in creating the overflow, the trial court was held by this court to have properly directed a verdict for him. However, while a lower estate is subject to the servitude of the natural flow of surface water from upper estates, the owner of a lower estate may recover damages from the owner of an upper estate if the latter, among other things, unreasonably changes the natural course of the water. The court found that the questions of whether defendant railroad, by constucting a new drainage system after plaintiffs had purchased their estates, unreasonably subjected plaintiffs' land to a servitude involving more than absorption of natural flow of water from upper estates, and whether plaintiffs at time of purchase were bound to anticipate such substantial change in the drainage situation, were for the jury. Thus the directed verdict for defendant railroad company was reversed. (Reed-Fla)
W69-05179

CRUTCHFIELD V F A SEBRING REALTY CO (INJUNCTION AGAINST REMOVAL OF LAKE WATER).

69 So 2d 328-330 (Fla 1954).

Descriptors: *Florida, *Lakes, *Non-navigable waters, *Riparian rights, Water rights, Judicial decisions, Water law, Bodies of water, Relative rights, Boundaries (Property), Irrigation systems, Pumping, Irrigation, Water levels, Water transfer, Ownership of beds.

Plaintiffs, as owners of a non-navigable lake and the land surrounding it, sued to permanently enjoin defendants from pumping water out of the lake across plaintiffs' land to irrigate citrus trees. Defendants based their right to remove water upon permission given defendants' predecessors in title to take limited amounts of lake water. The lower court, in granting the injunction, found that the volume of operation of defendants' pumps was endangering the level of the lake, and that the prior permission did not contemplate modern, large-scale removal. The appellate court in affirming the lower court stated that small lakes are susceptible of private ownership in Florida. It agreed that there was no intention to allow the large-scale irrigation. (Wheeler-Fla)
W69-05180

CAPES V BARGER (DAMAGES CAUSED BY DAM TO REPEL SURFACE WATERS).
109 NE 2d 725-727 (App Ct Ind 1953).

Descriptors: *Indiana, *Surface runoff, *Repulsion (Legal aspects), *Dams, Water low, Judicial decisions, Rain water, Surface waters, Surface drainage, Obstruction to flow, Legal aspects, Relative rights, Backwater, Damages, Overlying proprietor.

Plaintiff brought action against defendant, a lower adjacent landowner, for crop damage allegedly resulting from construction of a dam which caused water to back up on plaintiff's land. The lower court found for the defendant, holding that the damage resulted from surface water. On appeal, plaintiff argued that there was insufficient evidence to support a finding as to the nature of the water. The court overruled plaintiff's contention, holding that the evidence was sufficient to sustain the judgment below. The court followed the 'common enemy' rule allowing a landowner to dam against surface water draining onto his land, regardless of damage to upper owner by reason of accumulation of water above the obstruction. (Wheeler-Fla)
W69-05181

FAIRES V DUPREE (WATER POLLUTION FROM ANIMAL WASTES).
For primary bibliographic entry see Field 05B.
W69-05182

H B CARTER V CHUQUATONCHEE CONSOLIDATED DRAINAGE DISTRICT (DRAINAGE DISTRICT DISSOLUTION).
For primary bibliographic entry see Field 04A.
W69-05183

PARISH OF EAST BATON ROUGE V S AND H HEATING CO (CONDEMNATION).
216 So 2d 360-364 (1st Ct App La 1968).

Descriptors: *Louisiana, *Judicial decisions, *Eminent domain, *Condemnation value, Streambeds, Channels, Cost repayment, Drainage programs, Cities, Local governments, Severance, Damages, Costs, Prices.

Defendant owns certain property which extends to a point near the center of a creek bed. The portion within the creek is burdened by a servitude of drainage. Plaintiff in an expropriation suit sought to widen the creek in furtherance of a drainage program. The trail court awarded damages to defendant for the expropriated property outside the existing channel of the creek upon expert testimony based upon the prices received for comparable sales in the immediate vicinity. The court also awarded severance damages based upon the decrease in the permissive use that could be made out of defendant's land after the taking. Upon appeal the court held that the trial court's findings as to the value of the expropriated property outside the existing channel was not erroneous. However, the severance damages are predicated on speculation and are not allowable. (Molica-Fla)
W69-05184

STATE V REEDY CREEK IMPROVEMENT DISTRICT (PLEDGING OF PUBLIC CREDIT TO FINANCE DRAINAGE PROJECTS).
216 So 2d 202-208 (Fla 1968).

Descriptors: *Florida, *Drainage districts, *Financing, *Multiple-purpose projects, Drainage effects, Drainage, Legal aspects, Judicial decisions, Land reclamation, Public benefits, Recreation, Tourism, Pest control, Public health, Taxation, Legislation, Beds, Flood control, Flood protection, State governments.
Identifiers: Florida constitutional law.

The state sought to have drainage revenue bonds which were issued by the Reedy Creek Improvement District declared invalid. The District was established by the state legislature, and its enabling act authorized it to issue bonds to finance its drainage projects. The state claimed that the improvements primarily benefited private enterprise in derogation of the constitutional prohibition against pledging of public credit for private purposes. The court found this argument untenable and held that a public benefit would be derived as the drainage project would promote tourism and recreation. The legislature, in the exercise of its plenary authority, may create a multipurpose district encompassing more than one county. The district in question was validly created. The court concluded that the fees charged for the services of the project were not arbitrary and that the bonds as issued were valid. (Shevin-Fla)
W69-05185

SOUTHLAND CO V MCDONALD (POLLUTION OF WATERCOURSE BY ESCAPED CRUDE OIL).
For primary bibliographic entry see Field 05B.
W69-05186

UNITED FUEL GAS CO V SAWYERS (WELL POLLUTION THROUGH PERCOLATING WATERS).
For primary bibliographic entry see Field 05B.
W69-05187

VILLAGES - WATER WORKS.

Mich Comp Laws Ann secs 71.1-71.11 (1967).

Descriptors: *Michigan, *Local governments, *Water works, *Filtration, Legal aspects, Cities, Water supply, Water rates, Marketing, Water users, Treatment facilities, Condemnation, Canals, Reservoirs, Loans, Construction costs, Pipes, Distribution systems, Contracts.

Any village having a population of 200 or more may construct and operate a water works and filtration plant and for this purpose it may acquire reservoirs, canals, buildings, and real estate by condemnation, etc. The village council may borrow money for these purposes but not in excess of 10% of the assessed value of the property in the village. Serial bonds, the first payment on which shall not be due later than 3 years after the date of issue, shall be used for the loan at an interest rate not to exceed 6%. An estimate of the amount required to construct and operate the facilities and the question of raising money for such purposes shall be put to a referendum. Service pipes leading from the distributing pipes shall be at the customer's expense. The council shall establish a scale of variable water rates and steps to be taken to enforce payment thereof and any ordinances necessary for preservation of the facilities whether they be located within or without the village corporate limits. The council may contract with private persons for the supplying of water for periods not exceeding 10 years. (F. Molica-Fla)
W69-05188

IN RE CITY OF NEW YORK (STREAM BEDS).
2 N Y 2d 859, 161 NYS 2d 124-126 (1957).

Descriptors: *New York, *Ownership of beds, *Boundaries (Property), *Streambeds, Judicial decisions, Legal aspects, Navigable rivers, Tidal waters, High water mark, Cities, Condemnation, Eminent domain, Streams.

Claimant asserted title to a certain streambed on the basis of a patent from the state. The stream was included in damage parcels condemned by petitioner. The stream was included in damage parcels condemned by petitioner. The court held that a subsequent conveyance by the state granting all the land within certain boundaries, except that land previously granted, did not pass title to the streambed in question because it was a navigable stream. The patent to claimant is to be strictly construed and, in the absence of express grant of the land under the stream, the title to such land was not conveyed. (Molica-Fla)
W69-05189

ROUGHTON V THIELE KAOLIN CO (CHEMICAL POLLUTION BY UPPER RIPARIAN OWNER).
For primary bibliographic entry see Field 05B.
W69-05190

RIDDLE V BALTIMORE AND OHIO (FLOOD DAMAGE CAUSED BY INADEQUATE CULVERT).
For primary bibliographic entry see Field 04A.
W69-05191

WHITE V WOODARD (BOUNDARY LINE ALONG DITCH).
227 NC 332, 42 SE 2d 94-96 (1947).

Descriptors: *North Carolina, *Boundaries (Property), *Boundary disputes, *Ditches, Judicial decisions, Legal aspects, Rivers, Streams, Riparian rights, Ownership of beds.

Plaintiff and defendant each owned property with a common boundary. The deed to one parcel places the boundary line at a stake on a ditch and then with the ditch. The issue in this action is the establishment of the proper boundary line. The court stated that where a line is run to a stream or to a stake on a stream and thence with a stream, the intention is to extend the line to the middle of the stream, this being the true boundary unless language states otherwise. The court held that this rule should also apply to a ditch. A new trial was ordered to decide the issue of adverse possession. (Helwig-Fla)
W69-05192

RUFF V STIRES (ENTRANCE ON LAND TO REMOVE OBSTRUCTION TO FLOW).
82 NE 2d 116-118 (Ct App Ohio 1948).

Descriptors: *Ohio, *Legislation, *Obstruction to flow, *Excavation, Judicial decisions, Ditches, Drainage, Tile drainage, Weeds, Driftwood, Riparian rights, Land tenure, Legal aspects, Damages.
Identifiers: Trespass to land, Injunction (Prohibitory).

Plaintiff and defendant owned adjacent tracts of land through which flowed a creek. The defendant entered plaintiff's land to dredge out and enlarge the creek for land and tile drainage without the plaintiff's consent. Defendant claims to have entered under authority of an Ohio statute allowing any person to enter the land of another, after notice to the occupant, to remove any drift of wood or other substance forming an obstruction in a stream or watercourse, if such obstruction is injurious to the removing party (General Code sec 6727). A decree was entered for the plaintiff below, from which defendant appeals. The court of appeals held that the statute does not sanction the general excavation of a creek in order to insure drainage of adjacent land. When such an excavation causes injury not correctable by a damage award, an injunction may issue to prevent the trespass. When a statute sanctions what would otherwise be a trespass, it must be strictly construed. (Harris-Fla)
W69-05193

AUTHORITY TO LEVY TAXES FOR STREET IMPROVEMENTS.

Mich Comp Laws Ann sec 69.5 (1967).

Descriptors: *Michigan, *Local governments, *Taxes, *Sewage districts, Cities, Legal aspects, Legislation, Drains, Assessments, Costs, Cost sharing, Project planning, Financing, Annual costs, Construction costs.
Identifiers: *Street improvements.

A village council may use special assessments upon lands in sewer districts and special assessment districts to defray the cost of street improvements and drain and sewer construction and other local improvements. Such assessments shall be charged in proportion to frontage or benefits but may not exceed in any one year 5% of the assessed value of all property in the district chargeable with such expense. The money so raised may be held as a special fund to pay the costs of improvement or may be used to repay moneys borrowed therefore. (Molica-Fla)
W69-05194

POWERS OF COUNCIL.

Mich Comp Laws Ann secs 67.24-67.34 (1967).

Descriptors: *Michigan, *Drainage systems, *Sewers, *Local governments, Legal aspects, Legislation, Governments, Assessments, Government finance, Costs, Urbanization, Artificial watercourses, Taxes, Public utilities.

The council of any village may establish sewers, drains, and watercourses for drainage purposes; if necessary, private property may be used. Expenses for constructing these facilities may be defrayed by a general property tax and/or special assessments upon the lands benefited. The council may issue bonds bearing a maximum rate of 6% to fund the improvements. The council shall prepare and publish a map of those lands which will benefit from the drainage if a special assessment is used. The council may require owners and occupants of

land to construct private drains therefrom to connect with the public sewers and it can enforce such orders. Private owners and occupants have the right to connect to the public sewers at their own expense. An annual charge not exceeding $2.00 may be imposed as a sewer charge. Repair expenses of public sewers, etc., may be paid by a general tax. The council may enact ordinances necessary to carry into effect its powers and for the control and protection of the facilities. (F. Molica-Fla)
W69-05195

WATERWORKS.
Mich Comp Laws Ann sec 41.413a (1967).

Descriptors: *Michigan, *Waterworks, *Utilities, *Public utility districts, Public benefits, Legislation, Legal aspects, Administrative agencies, Local governments.

Any waterworks in any district shall be under the control of a Board of Public Service Commissioners. The Board shall consist of five members elected by the voters of said district. The members must be residents of the district. The terms of the board members shall be staggered. The Commission shall have the authority to hire necessary employees to carry out the purposes of this act. (Shevin-Fla)
W69-05196

NASS V TOWN OF DUXBURY (DIVERSION OF FLOW BY CHANNEL OBSTRUCTION).
For primary bibliographic entry see Field 04A.
W69-05197

BOROUGH OF COLLEGEVILLE V PHILADELPHIA SUBURAN WATER CO (ADMINISTRATIVE REMEDIES FOR WATER DIVERSION).
377 Pa 636, 105 A 2d 722-732 (1954).

Descriptors: *Pennsylvania, *Appropriation, *Diversion, *Administrative decisions, Leglislation, Dam construction, Water supply, Watershed management, Administrative agencies, Reservoirs, Permits, Judicial decisions, Legal aspects, Water conveyance, Public benefits, Water sources, Eminent domain, Condemnation.
Identifiers: *Water and Power Resources Board.

Plaintiffs brought suit against defendant water company seeking to enjoin it from appropriating and diverting water from a creek and from erecting a dam across the creek in order to create a reservoir for taking water. Plaintiffs also sought to enjoin defendant from condemning or acquiring by eminent domain or otherwise any water, lands or rights whatsoever within the watershed. The Water and Power Resources Board had issued a permit to the defendant to engage in the activities complained of by the plaintiffs. Numerous public hearings were conducted prior to the issuance of the permit. At issue was whether the plaintiffs had sufficiently exhausted all available administrative remedies and thus fulfilled the condition precedent to jurisdiction of an equity court. The court held that it lacked jurisdiction since plaintiffs had failed to appeal the Board decision to the court designated by the enabling statute and therefore had not exhausted all available administrative remedies. The order of the lower court dismissing the complaint was affirmed. (Katz-Fla)
W69-05198

PHILLIPS PETROLEUM CO V HARDEE (LIABILITY FOR DAMAGE BY POLLUTION).
For primary bibliographic entry see Field 05G.
W69-05199

DRUMMOND V FRANK (OBSTRUCTION OF SURFACE FLOW).
For primary bibliographic entry see Field 04A.
W69-05200

6F. Nonstructural Alternatives

A NEW METHOD OF MAPPING THE WATER RESOURCES,
Northern Research Inst. of Hydraulic Engineering and Reclamation, Kazan (USSR). Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 02E.
W69-04934

A METHOD OF DETERMINING THE AVAILABLE SURFACE WATER RESOURCES,
Institut fuer Wasserwirtschaft, Berlin (East Germany).
For primary bibliographic entry see Field 02E.
W69-04950

PLANNED UTILIZATION OF WATER RESOURCES,
TRW Systems, Redondo Beach, Calif.
For primary bibliographic entry see Field 02E.
W69-04952

OPTIMAL FLOOD DAMAGE MANAGEMENT: RETROSPECT AND PROSPECT,
Resources for the Future, Inc., Washington, D. C.; Chicago Univ., Ill.
For primary bibliographic entry see Field 06B.
W69-05118

6G. Ecologic Impact of Water Development

FIRST WORLD CONFERENCE ON NATIONAL PARKS.

National Park Service, Department of the Interior, Washington, D. C., June 30-July 7, 1962.

Descriptors: *National parks, *Wildlife conservation, *Ecology, Natural resources, Scenery, Federal reservations, Parks, Conservation.

Scientific, economic, and cultural values of national parks are analyzed by the delegates to the conference. The preservation of wildlife in its natural habitat is discussed. The public should be educated by the national parks to appreciate and preserve plant and animal life in its original habitat.
W69-04990

CHESAPEAKE COUNTRY,
Nathaniel T. Kenney.
National Geographic, Vol 126, No 3, September, 1964, pp 370-411.

Descriptors: *Maryland, *History, *Social impact, *Economic impact, *Bays, Appalachian Mountain region, Atlantic coastal plain, Coastal plains, Geographical regions, Northeast U. S., Regions, Social aspects, Bodies of water.

This article briefly covers social and economic aspects of the development of Chesapeake Bay.
W69-05010

07. RESOURCES DATA

7A. Network Design

BASIC DATA COLLECTION FOR WATER DEVELOPMENT IN EAST PAKISTAN,
East Pakistan Water and Power Development Authority, Dacca. Water Investigation.
A. Matin.
For the 8 Volume Proceedings, see Vol 2, No 9, Vield 06B, W69-03305. Int Conf on Water for Peace, Wash, D C, Vol 4, pp 298-308, 1968. 11 p, 2 fig, 2 tab.

Descriptors: *Planning, *Data collections, *River basin development, *Deltas, Water resources, Social aspects, Legal aspects, Land use, Topography, Geology, Economics, Meteorology, Irrigation, Agriculture, Industrial production.
Identifiers: Brahmaputra-Ganges-Meghna delta, Pakistan, East Pakistan.

Most of East Pakistan lies in the delta of the Ganges, Brahmaputra, and Meghna Rivers, one of the largest and most densely populated deltas in the world. The climate is tropical except in the winter when it may be classed as sub-tropical. During the summer, the region is subject to local flooding from monsoon rainfall and general flooding from the over-flow of the converging rivers whose total peak flow may be as great as 6 million cfs. During the winter, drought conditions prevail. From time to time devastating tropical cyclones (called hurricanes or typhoons elsewhere) accompanied by torrential rains have devastated the land. Large amounts of sediment are carried by the major streams, particularly the Brahmaputra. The extent of groundwater in East Pakistan has not been determined but needs detailed investigation. Food for an adequate diet for everyone has not been available in the Province for many years. Food production is increasing at a lower rate than population growth. Basic data must be collected for use in the planning which is necessary to develop the agriculture and industry necessary to support even the provinces present population. Surface water data on water levels of streams, discharge, and suspended load and bed load are being collected. Studies relating to the optimum uses of irrigation water are being made at the Agricultural Experimental Farms at the various parts of the Province. Studies about population, general health and nutrition habits of various social groups need to be made. Data concerning education levels, employment and economic status of various groups supplies helpful planning information. Other socio-economic studies connected with the planning have also to be made. (Knapp-USGS)
W69-04755

CHEMICAL MEASUREMENT OF MEAN TEMPERATURE,
Pennsylvania State Univ., University Park.
Richard Lee, and E. B. Jones.
Water Resources Bull, Vol 4, No 4, pp 39-45, Dec 1968. 7 p, 3 fig, 1 tab, 8 ref.

Descriptors: *Temperature, *Hydrolysis, *Data collections, *Methodology, Analytical techniques, Heat budget, Hydrologic aspects, Solar radiation, Evaporation, Consumptive use, Thermal pollution, Climatology, Pennsylvania, Irrigation.
Identifiers: *Mean temperature, *Chemical method.

The significance of mean temperature to hydrology, methods of integrating temperature over time, problems involved, and appropriate application areas for the chemical mean temperature method are discussed. A versatile methodology, based on the temperature dependence of sucrose hydrolysis, was tested in Pennsylvania. The technique permits low-cost mass sampling of air, water, and soil temperatures. Because the sensing elements are transparent, short-wave radiation effects are negligible. In field tests duplicate sensors yield repeatedly the same values plus or minus 0.02 deg C. Data can be related directly to measurements obtained in standard climatological networks. The technique has good application in such hydrological studies as evaporation, consumptive use, thermal pollution, and soil moisture in irrigation practices. (Lang-USGS)
W69-04765

SCIENTIFIC PARAMETERS OF MARINE WASTE DISCHARGE,
For primary bibliographic entry see Field 05A.
W69-05018

7B. Data Acquisition

THERMAL INFRARED IMAGERY FOR GEOLOGISTS,
Chevron Research Co., La Habra, Calif.
Floyd F. Sabings, Jr.
Pap, Chevron Oil Field Res Co, La Habra, Calif, 1968. 21 p, 5 fig, 2 plate, 6 ref.

Descriptors: Thermal radiation, *Infrared radiation, Infrared rays, Thermal pollution, Aerial photography, Geological surveys, Engineering geology, Geologic formations, *Geologic investigations, Geology, Remote sensing, *Geologic mapping, Sensors, Instrumentation, *Reconnaissance surveys.
Identifiers: Infrared sensors, *Infrared imagery, Infrared scanning, *Aerial reconnaissance, *Airborne surveying, Photointerpretation.

Thermal infrared imagery is obtained by airborne scanning devices that detect thermal radiation from the earth's surface and record it as an image; bright tones represent relatively warm radiometric temperatures and dark tones represent relatively cool temperatures. Scanners sensitive to wave lengths between 8 and 14 microns span the radiant power peak of the earth at 9.7 microns and coincide with an atmospheric window. An example of 8-14 micron nighttime infrared imagery from the Imperial Valley, Calif, is compared with aerial photographs of the same area. In this monotonous-appearing desert terrain the imagery exhibits greater contrast and geologic detail than the photography. The imagery distinguishes deformed tertiary sedimentary bedrock (relatively cool) from recent windblown sand cover (relatively warm). A faulted plunging anticline in flat terrain is obscure on aerial photographs and to the ground observer. On nighttime infrared imagery the fold is clearly shown by the outcrop configuration of the individual siltstone and sandstone strata. The radiometric temperature differences between strata are sufficient to outline the fold on the imagery. (USBR)
W69-04745

THERMAL CONDUCTIVITY OF TWO-PHASE POROUS MATERIALS: DRY SOILS,
Rajasthan Univ., Jaipur (India). Dept. of Physics.
D. R. Chaudhary, and R. C. Bhandari.
Brit J Appl Phys (J Phys D), Ser 2, Vol 2, No 4, pp 609-610, Apr 1969. 2 p, 1 fig, 3 ref.

Descriptors: *Thermal conductivity, *Porous media, *Heat flow, Geothermal studies, Physical properties, Methodology, Mathematical studies, Porosity.
Identifiers: *Dry soils, Experimental values.

The weighted geometric mean of maximum and minimum thermal conductivities for calculating effective thermal conductivities of porous media has been applied to unconsolidated dry materials. The relation was tested with values obtained experimentally by Smith (1942) for Miami silt loam, and found to have fair agreement. For porosities ranging from 57 to 33 % the values of n lie between 42 and 51 %. This shows that the distribution phases in an unconsolidated system is probably stratified along and perpendicular to the direction of heat flow. (Lang-USGS)
W69-04949

TWO METHODS OF ESTIMATING BASE FLOW AT UNGAGED STREAM SITES IN KANSAS AND ADJACENT STATES,
Geological Survey, Lawrence, Kan.; Geological Survey, Albany, N. Y.
For primary bibliographic entry see Field 02E.
W69-04978

MAGNETIC TAPE RECORDING OF GEOPHYSICAL LOGS,
Geological Survey, Denver, Colo.
W. Scott Keys.
Geol Surv Res 1967, Prof Pap 575-C, pp C242-C246, 1967. 5 p, 4 fig, 4 ref.

Descriptors: *Logging (Recording), *Borehole geophysics, Research and development, Instrumentation, Electronic equipment, Geophysics.
Identifiers: Geophysical log tape recorder.

An inexpensive magnetic tape system has been developed and used for recording geophysical well logs. The unmodified signal from a logging probe is recorded simultaneously with the conventional graphic log. During tape playback, all adjustments normally made during logging are possible. These include independent changes in horizontal scale, vertical scale, zero positioning, and time constant. Use of this system reduces the time spent at the well. Correction of operator errors and equipment malfunctions can be done in the office, and logs can be plotted at any time in a format consistent with the planned use. This system also provides for the economical storage and retrieval of data. (USGS)
W69-04986

MEASUREMENT OF THE ABUNDANCE OF FRACTURE TRACES ON AERIAL PHOTOGRAPHS,
Geological Survey, Washington, D. C.
For primary bibliographic entry see Field 02F.
W69-04987

FIELD CORRELATION OF TWO NEUTRON-SCATTERING SOIL MOISTURE METERS,
Forest Service (USDA), Logan, Utah. Intermountain Forest and Range Experiment Station.
John D. Schultz.
U. S. D. A. Forest Serv. Res. Note INT-21, 1964, 7 pp.

Descriptors: *Nuclear meters, *Radioactivity, *Depth-area-duration analysis, *Instrumentation, Calibrations, Soil moisture meters, Water measurement, Moisture uptake, Hydrologic data, Moisture availability, Soil analysis, Linear programming.
Identifiers: *Probe correlation, *Depth referencing, *Field correlation, *Neutron-scattering method.

Operation of two neutron soil moisture probes of different design was compared under identical conditions. Reports development of a method for depth referencing one probe with respect to the other for obtaining moisture measurements at comparable depths. Correlation curves for data obtained with both probes indicate the best relative positioning of these two probes when one is employed in lieu of the other.
W69-05100

EVAPOTRANSPIRATION AND SOIL-MOISTURE DEPLETION,
Forest Service (USDA), Moscow, Idaho. Intermountain Forest and Range Experiment Station.
For primary bibliographic entry see Field 02G.
W69-05102

A HEATING SYSTEM FOR STREAM GAGING STATIONS,
Forest Service (USDA), Logan Utah. Intermountain Forest and Range Experiment Station.
Robert D. Doty, and Robert S. Johnston.
Journal of Soil and Water Conservation, 1967, Vol 22, No 6, 2 pp.

Descriptors: *Stream gages, *Gaging stations, *Water measurement, *Structural design, *Heating, Infrared radiation, Propane, Flumes, Fuels, Operating cost, Total cost, Watershed management, Stilling basins.
Identifiers: *Streamflow measurement, *Stilling well heater.

A heating system was developed for keeping small mountain stream gaging stations free of ice. The system includes a propane heater for the stilling well, propane infrared heater for an 'H' type flume, and covers for the entire flume assembly. The stilling well heater is equipped with safety shutoff and operates on a minimum of fuel, while the flume heater utilizes approximately 300 gallons of fuel over a 6-month period in order to obtain a 12,000 BTU output. The paper explains the construction of all units of the system and includes cost of construction and operations.
W69-05110

THE INTERMOUNTAIN PRECIPITATION STORAGE GAGE,
Forest Service (USDA), Logan Utah. Intermountain Forest and Range Experiment Station.
Norbert V. DeByle, and Harold F. Haupt.
U.S.D.A. Forest Serv. Res. Note INT-34, 1965, 4 pp.

Descriptors: *Precipitation gages, *Rain gages, *Watershed management, *Water measurement, *Water management, Gaging stations, Rain water, Structural design, Water yield improvement, Antifreeze.

A modified standpipe is recommended as a rugged, vandalproof precipitation storage gage that is relatively easy to erect. It has proved satisfactory on sites receiving 60 inches or less of precipitation during the storage season.
W69-05111

GEOPHYSICAL STUDIES FOR VOLCANOLOGICAL GEOHYDROLOGY,
Hawaii Inst. of Geophysics, Honolulu.
William M. Adams.
Hawaii Water Resources Research Center, Contrib No. 18, Feb 1969. 23 p, 12 fig, 21 ref. OWRR Project B-008-HI.

Descriptors:
Identifiers: *Volcanology, *Geohydrology, Infrared, Gravity, Radar, Magnetics, Seismics, Resistivity, Algae, *Hawaii, Dikes.

Infrared scanning, when judiciously applied and interpreted with the aid of concomitant surface measurements, is an effective reconnaissance method for large regions. Radar imagery has been studied theoretically. Index algae are indicators of freshwater outflow and are not dependent on temperature. False-color procedures have been developed for locating the index algae from aircraft. Close-spaced gravity and electrical resistivity profiling seem to locate dike zones and hence define sectors of the ground-water table having approximately the same elevation. Depths to the water table are estimated from electrical resistivity sounding or audiomagnetotelluric soundings. Drilling at a few sites has confirmed estimated depths, however, estimates of porosity based on absolute resistivities do not seem reliable. Applications of aeromagnetics and seismic holography are being developed. For any given situation, the appropriate techniques depend on the environment and prior knowledge. For volcanological insular environments, electrical resistivity and aeromagnetics should be considered. Audiomagnetotellurics may be appropriate in a simple geometry at an elevation above a thousand feet.
W69-05145

7C. Evaluation, Processing and Publication

ELECTRONIC DATA PROCESSING SYSTEM FOR STREAMFLOW,
Southern Great Plains Watershed Research Center, Chickasha, Okla.
Russell R. Schoof, Edward H. Seely, Arlin D. Nicks, Carlton D. Edens, and Paul B. Allen.
Water Resources Bull, Vol 4, No 4, pp 54-63, Dec 1968. 10 p, 3 fig, 4 tab, 2 ref.

Descriptors: *Computer programs, *Digital computers, Hydrologic data, Data processing, Data collections, Streamflow, Runoff, Water levels, Sediment transport, Sediment load, Networks.
Identifiers: Hydrologic data processing.

A digital computer system was developed to calculate daily, monthly, and yearly summaries of streamflow and sediment transport from continuous gage height records and discrete sediment concentrations and discharge measurements. The system includes computer computation of discharge measurement notes and an accuracy check of gage height and time input data. Maximum volumes of runoff for selected time intervals up to 8 days and flow duration data can also be compiled. Electronic data processing equipment consists of a chart reader, card punch, computers, and card sorter, and the system software includes 12 Fortran programs. (Knapp-USGS)
W69-04759

LINEAR--A COMPUTER PROGRAM TO FIT DATA EASILY TO MANY MODELS BY THE WEIGHTED LINEAR LEAST-SQUARES METHOD,
Oak Ridge National Lab., Tenn.
E. Schonfeld.
July 1968 22 p W-7405-eng-26 ORNL-4264.

Descriptors: *Computer programs, *Digital computers, *Data processing, Computers, Programming languages, Regression analysis, Statistical methods.
Identifiers: *Weighted linear least-squares method, FORTRAN, LINEAR, Terminology, CDC-1604, FORTRAN II (IBM-7090), FORTRAN 62 (CDC-1604, -3600), FORTRAN 63 (CDC-1604,-3600), FORTRAN 360-ORNL (IBM-360), FORTRAN IV (IBM-7094/0), FORTRAN IV (IBM-360), FORTRAN IV (UNIVAC-1108), FORTRAN ASA.

Computer PROGRAM LINEAR, written in FORTRAN, permits convenient fitting of models, by weighted linear least-squares method, of polynomials involving up to 10 independent variables. Program includes sub-routines for eight procedures for regression of dependent variable (Y) on independent variables (X) thus: both variables coded, log-to-base-e of coded Y on coded X, log-to-base-e of coded Y on log-to-base-e of coded X, ratio of coded X to coded Y on coded X, coded Y on reciprocal of coded X, log-to-base-e of coded Y on reciprocal of coded X, reciprocal of coded Y on reciprocal of coded X, coded Y squared on coded X. Program permits option of introducing user's own data transformation and polynomial. Program includes matrix inversion routine which is easily modified to double precision. Execution on CDC-1604 requires about one minute; costs about $1-2. LINEAR can be used with different computers and FORTRAN languages including II (IBM-7090), 62 (CDC-1604, -3600), 63 (CDC-1604, -3600), 360-ORNL (IBM-360), IV (IBM-7094/0), IV (IBM-360), IV (UNIVAC-1108), ASA. Report includes simplified and complete instructions for program use; glossary; printout of PROGRAM LINEAR; and examples of input, selected output, and detailed output of procedures 1-4. (Eichhorn-Wis)
W69-04797

DOCUMENTATION: INFORMATION AND INSTRUCTION CONCERNING THE PROBLEMS OF WATER,
Centre Francais d'Information de l'Eau.
For primary bibliographic entry see Field 10.
W69-04940

AN OPTIMIZATION CRITERION FOR MULTISPECTRAL PHOTOGRAPHY,
Hawaii Inst. of Geophysics, Honolulu.
William M. Adams.
Hawaii Water Resources Research Center, Contrib No. 12, Dec 1968. 37 p, 20 fig, 5 ref. OWRR Project B-008-HI.

Descriptors:
Identifiers: Multispectral photography, Optimization, Imagery, Pattern recognition, Spectral matching.

The procedures for gathering and processing information by multi-spectral photography have been heuristic and often limited by the equipment. The equipment limitations will probably continue. The purpose of this paper is to indicate that the procedures, especially the analysis, do not necessarily need to be heuristic. The problem is separated into two types of decision-making situations: the pure spectrum case, in which the desired signal is known and may be observed without noise contamination, and the mixed spectrum case, in which the desired signal is known but is not observed without some noise contamination. The pure-spectrum case is reduced to a problem of pattern recognition. The mixed spectrum case is studied for development of a 'best' system is found and three examples demonstrate the results. Exposure time is not considered as a variable in the theory.
W69-05144

08. ENGINEERING WORKS

8A. Structures

ANALYSIS OF THE FAILURE OF BRITTLE MODELS OF ARCH DAMS,
Ya K Kul'gavii.
Hydrotech Constr, No 4, pp 328-332, Apr 1968. 5 p, 4 fig, 1 tab, 8 ref.

Descriptors: *Arch dams, *Concrete dams, *Model studies, *Model tests, Models, Structural analysis, Structural behavior, Gypsum, Cracks, Safety factors, Elasticity modulus, Dam foundations, Failure (Mechanics), Load distribution, Hydrostatic pressure, Cracking, Deflection, Foreign research.
Identifiers: USSR, *Double-curvature arch dams, Design assumptions.

Failure tests on 13 brittle models of arch dams were performed in 1964-65 at the mechanical laboratory of the Leningrad Institute of Railroad Transportation Engineers. Since the height of the models was only 30 cm, the accuracy of numerical results is questionable. All models were made at a scale of 1:1000. Double-curvature arch and conical-section arch dams were modeled. Design loads were determined, assuming the specific weight of the fictitious liquid to be 100 tons/cu m and the unit weight of the concrete to be 240 tons/cu m. The models of the base and dams were cast from a gypsum-sand mix using a gypsum:sand:water ratio of 1:1:0.8. Two schemes of limit equilibrium of arch dams were developed: (1) when failure of models is caused by hydrostatic pressure, horizontal and perimetral cracks appear first and vertical cracks are secondary, and (2) when failure of models is due to total loads, vertical and perimetral cracks are characteristic and horizontal cracks are secondary. The deadweight of the structure upon failure caused by total load promotes a greater stability of the models and permits a more realistic estimate of the safety factor. The safety factor increases 10% for double-curvature models and 20% for models with a vertical upstream face. (USBR)
W69-04710

ELECTRIC-ARC EQUIPMENT FOR BURNING OPENINGS INTO BRICK AND REINFORCED CONTRETE STRUCTURES,
K. E. Gorianinov, and V. I. Antropov.
Transl from Russ, Bur Reclam Transl 721, Jan 1968. 8 p, 3 fig, 2 ref. Mekh Stroitel, No 2, pp 18-19, 1967.

Descriptors: *Electric arcs, *Cutting, Burning, Aperture, Electrodes, Costs, Electric power, Manpower, Field tests, Electric insulation, Beams (Structural), *Bricks, *Reinforced concrete, Slabs, Offsets, Apparatus, Construction, Foreign research, Circles, Electrical equipment, *Masonry, Fusion, Slags, Economics.
Identifiers: USSR, *Equipment design, Plasma jet.

USSR inventors have developed and successfully tested an apparatus for cutting openings, furrows, recesses, and offsets by electric-arc and plasma destruction of brick and reinforced concrete. The equipment is equally adaptable to new construction or remodeling existing structures. The electric arc can demolish concrete, reinforced concrete, or masonry; form passages, recesses, and furrows in walls and slabs; cut concrete and rock to true geometric shape; pierce communication openings; and level concrete piles driven to refusal. The operating principles is based on fusion of the material by an electric arc at 4000 to 8000 deg C, forming an ionized zone and ejection of the fused slag by electrodynamic forces. The equipment is described, and savings in money, time, and manpower are indicated. The mobile apparatus weighs 50 kg, requires 64 kw of power, and is operated by one worker using a standard welder's shield.
W69-04718

EARTHQUAKE BEHAVIOR OF RESERVOIR-DAM SYSTEMS,
California Univ., Berkeley.
Anil K. Chopra.
Proc Amer Soc Civ Eng, J Eng Mech Div, Vol 94, No EM6, pp 1475-1500, Dec 1968. 26 p, 8 fig, 17 ref, 2 append.

Descriptors: Concrete dams, *Gravity dams, *Seismic properties, *Dams, *Earthquakes, Earthquake engineering, Structural behavior, Damping, Dam design, Seismic investigations, Seismic studies, Vibrations, Excitation, Compressibility, Hydrodynamics, Reservoirs, Bibliographies, Engineering mechanics.
Identifiers: Earthquake loads, Earthquake-resistant struct, Seismic stability, Dynamic response, Hydrodynamic pressures.

Most analysis of earthquake effects on dams treats the dam and the reservoir as 2 uncoupled systems. Importance of interaction between the 2 systems is investigated. The analysis is restricted to dams with a vertical upstream face. This idealization is considered appropriate for concrete gravity dams. Dam response is assumed to be satisfactorily represented by the fundamental mode effects. Expressions are derived for complex frequency responses of a coupled system. For the coupled system, the complex frequency responses, the fundamental vibration period, and responses to stationary white noise excitation are numerically evaluated for wide range of the basic parameters: (1) normalized excitation frequency, and (2) the ratio of fundamental natural frequencies of the reservoir and dam separately. Interaction effects have considerable influence on the behavior of the system. Analysis of the coupled system is greatly simplified when water compressibility is neglected. The earthquake response can then be determined as the response of a modified one-degree of freedom system. Compressibility of water can be ignored if the dam is flexible enough compared to the reservoir. (USBR)
W69-04726

THE MOSSYROCK DEVELOPMENT,
Harza Engineering Co., Chicago, Ill.; Tacoma Dept. of Public Utilities, Wash.
Earl J. Beck, and Frankland Smith.
Water Power, Vol 20, No 11, pp 431-438, Nov 1968. 8 p, 10 fig.

Descriptors: *Arch dams, *Hydroelectric power, Hydrology, Model tests, Engineering geology, Diversion tunnels, Laboratory tests, Powerhouses, Trial-load method, Foundation investigations, Spillway gates, Penstocks, Spillways, Fish passages, Fish hatcheries, Construction, Concrete dams, Transmission (Electrical), Costs, Washington.
Identifiers: *Double-curvature arch dams, *Mossyrock Dam (Wash), Cowlitz River (Wash), Hydroelectric resources.

Mossyrock is the second of 2 developments on the Cowlitz River owned by the City of Tacoma, Wash, the first being Mayfield completed in 1963. Mossyrock has a double-curvature arch dam 606 ft high

with a crest length of 1300 ft. The conventional indoor powerplant, containing two 150-mw generating units with provisions for a future unit of the same size, is located on a bench in the right abutment of the dam. The dam is the highest in Washington and the third highest concrete dam in the U. S. Spillway crest gates are incorporated in the arch with the discharge falling freely into a plunge pool below the dam. The hydrology of the river basin, geology and foundation conditions, river diversion, foundation treatment, arch dam and spillway, powerplant, and fish facilities are discussed. The dam was analyzed by trial-load analysis, aided by a computer. Structural tests on a 1:400 scale model were conducted by Laboratorio Nacional de Engenharia Civil in Portugal. A spillway model was tested at the Hydraulic Laboratory, University of Washington. (USBR)
W69-04737

THE SOLINA HYDRO PROJECT,
A. Kurhanowicz.
Water Power, Vol 20, No 12, pp 475-480, Dec 1968. 6 p, 7 fig, 1 tab.

Descriptors: *Water resources development, River basin development, *Hydroelectric power, Hydroelectric plants, *Pump turbines, Penstocks, Francis turbines, Flood control, Industries, Agriculture, Concrete dams, Tourism, Gravity dams, Foreign design practices, Reservoirs, Peak power, Reservoir operation.
Identifiers: Poland, Carpathian Mountains, *Solina Project (Poland).

Constructing the dam and hydroelectric powerplant at Solina on the River San in Poland is one stage in developing the Carpathian water resources. This will be the second in a chain of 16 powerplants in the cascade, and will be the largest in Poland. The Solina reservoir is designed: (1) to provide flood control on the upper San River; (2) to produce peakload power for savings in coal, and eventually provide the basic source for the power system of Eastern Poland; and (3) to promote development of industry, agriculture, and tourism in the Bieszczady region, Two 46-mw Francis turbine units and two 21.2-mw pump-turbine units will be installed in the Solina powerplant. Geology of the region, technical and economic aspects of selecting a concrete gravity dam, alternative design considered for the powerplant structure and installed equipment, capacity and operation of the reservoir, and the construction program are discussed with emphasis on the civil engineering aspects of the project. The permanent-type construction village will be used as a health center after dam completion. (USBR)
W69-04738

PROBABLE MAXIMUM PRECIPITATION OVER SOUTH PLATTE RIVER, COLORADO AND MINNESOTA RIVER, MINNESOTA,
Weather Bureau, Silver Spring, Md.
For primary bibliographic entry see Field 04A.
W69-05158

FONTENOT V SMITH (CONTRACT AGREEMENTS AND RIGHTS TO NATURAL FLOW).
For primary bibliographic entry see Field 06E.
W69-05170

8B. Hydraulics

FLUID DYNAMICS,
Clarkson Coll. of Technology, Potsdam, N. Y.; Rensselaer Polytechnic Inst., Troy, N. Y.
William N. Gill, Robert Cole, and Joseph Estrin.
Ind Eng Chem, Vol 61, No 1, pp 41-75, Jan 1969. 35 p, 704 ref.

Descriptors: Fluid flow, *Hydraulics, *Hydrodynamics, Entrances, Jets, Gases, Laminar flow, Non-Newtonian flow, Stratified flow, Cavitation, Suspended solids, Air, Bubbles, Drops (Fluids), Suspended sediments, Solids, Sedimentation, Mixes, Mixing, Porous media, Flow around objects, Turbulent flow, Boundary layers, Bibliographies, Reviews.
Identifiers: *Fluid dynamics, Newtonian flow, Two-phase flow, Liquid films, Solid solutions, Fluidized-bed coating.

A critical review is given of fluid dynamics literature published from Jan to Dec 1967. An effort was made to include both breadth and depth of coverage. The reviewers also restricted coverage to papers emphasizing development and delineation of basic principles rather than practical applications. Among fields of fluid dynamics reviewed are single-phase laminar flow of Newtonian fluids in channels; entrance regions; isothermal flow; coupled flow; two-phase flow; cavitation; liquid films; stratified flow; bubble dynamics; drop formation and motion; solid-fluid systems; suspension behavior--sedimentation; fluidized beds; porous media; rotating flow; non-Newtonian fluids; natural convection and related flows; laminar flow past submerged objects; boundary layer flow; jets; turbulence; wakes; and turbulent non-Newtonian flow. (USBR)
W69-04701

ENTRY VELOCITY CONTROL LIMITS DRAIN SEDIMENTATION,
Agricultural Research Service, Brawley, Calif.; and Agricultural Research Service, Columbus, Ohio.
Lyman S. Willardson, James L. Fouss, and Ronald C. Reeve.
Proc Amer Soc Civ Eng, J Irrig Drain Div, Vol 94, No IR4, pp 455-463, Dec 1968. 9 p, 4 fig, 1 tab, 10 ref, append.

Descriptors: *Entrances, *Velocity, *Subsurface drains, *Drains, Fluid flow, Drain tiles, *Drainage, *Sedimentation, *Inlets (Waterways), *Sediment control, Design criteria, Laboratory tests, Hydraulics, Stokes Law, Channels, *Deposition (Sediments), Particle size, Cross-sections.
Identifiers: Openings.

Sedimentation of subsurface drains can be prevented by controlling water entry velocity. The essential element is an entrance flow channel for controlling direction and magnitude of the inflow velocity. This concept can be implemented in several ways using a variety of materials. The channel must flow directly upward opposite the gravity field for some distance before water enters the drain; the magnitude of the flow rate must be less than a critical limiting velocity that would dislodge and lift soil particles. The entry velocity can be limited by providing sufficient channel inflow cross-sectional area, varying either the size and number, or both, of channels, to meet the drainage discharge requirements. Laboratory tests show that uniform-size noncohesive particles will probably cause sedimentation problems. Graded materials and cohesive aggregated soils are less susceptible to movement by flowing water. Preliminary design criteria, based on the average Stokes Law settling velocity in upflow channels, were established. An average velocity in the entrance flow channel that is less than 10% of the Stokes Law settling velocity for the smallest size soil particle to be excluded appear safe. (USBR)
W69-04720

TENTATIVE DESIGN PROCEDURES FOR RIPRAP-LINED CHANNELS,
Minnesota Univ., Minneapolis.
Alvin G. Anderson, Amreek S. Paintal, and John T. Davenport.
Res Results Dig, Highw Res Board, Dig 1, Dec 1968. 24 p, 1 tab, 19 chart.

Descriptors: Channel erosion, *Channels, Design criteria, Hydraulics, Design tools, *Hydraulic design, Hydraulic properties, Linings, *Riprap, Canal design, *Canal linings, Ditches, Economics, Slope protection.
Identifiers: *Channel protection, Design assumptions, *Channel design, Design practices, *Lined canals.

Criteria are developed and procedures extended for designing roadside drainage channels for conditions intermediate between those for which easily established grass cover will suffice and those for which paved channels or pipe flumes are more economical. Design charts facilitate rapid and simple establishment of channel shape and size and properties of the riprap lining. Regular trapezoidal channels with a maximum discharge of 1000 cfs and median or side ditches with a maximum discharge of 100 cfs are the 2 primary types (both with a maximum slope of 0.10) chosen for preparing design charts. Side ditches are relatively wide and often approach a triangular cross section because of flat slopes. An equation is developed relating the discharge, longitudinal slope, riprap size, and shape of a regular trapezoidal channel. The channel shape can be eliminated as a design factor from wide triangular channels; erosion control will depend primarily on the discharge, longitudinal slope, and riprap size. (USBR)
W69-04727

VELOCITY DISTRIBUTION AND ITS EFFECT ON THE ACCURACY OF THE GIBSON METHOD OF WATER MEASUREMENT,
Allis-Chalmers Mfg. Co., York, Pa.
For primary bibliographic entry see Field 08C.
W69-04744

HORIZONTAL DIFFUSION FROM AN INSTANTANEOUS POINT SOURCE DUE TO OCEANIC TURBULENCE,
For primary bibliographic entry see Field 02L.
W69-05036

A REVIEW OF THEORETICAL MODELS OF TURBULENT DIFFUSION IN THE SEA,
For primary bibliographic entry see Field 02L.
W69-05037

MICROSCOPIC DETERMINATION OF BOUNDARY SHEAR AND SUBLAYER TURBULENCE CHARACTERISTICS IN AN OPEN CHANNEL,
Illinois Univ., Urbana.
Harry G. Wenzel, and Michael J. Mathews.
Illinois Water Resources Center, Research Report No 13, January 1968, vii + 78 p, 25 fig, 3 tab, 20 ref. OWRR Project A-006-ILL.

Descriptors: Boundaries (Surfaces), Boundary layers, *Flow profiles, Hydraulics, Laminar flow, Microscopy, *Open channel flow, Photography, *Shear stress, Turbulence, *Turbulent boundary layers, Turbulent flow, Velocity.
Identifiers: Boundary shear, *Rate of shear, Suspended particles, *Turbulence intensity, Two-dimensional flow.

The application of a method of velocity determination in an open channel using a microscope and camera to record the motion of small particles suspended in water is described. Velocity measurements were made in a series of thin planes orientated parallel to the channel bottom for the case of two-dimensional laminar and turbulent open channel flow. Velocity profiles near the boundary were plotted and boundary shear computed from the rate of shear thus determined. Turbulence intensity was computed and the distribution of particle velocities examined. It was concluded that the method yields boundary shear values to within plus or minus 15 percent and that this uncertainty can be reduced significantly. The maximum error is caused by uncertainty in the location of the focal plane and in the location of a particle within the focal plane. This difficulty causes an even greater error in computation of turbulence intensity. This error increases as the distance from the boundary decreases, creating a serious disadvantage of the method. Particle velocity distributions exhibit a

positive third moment which is in qualitative agreement with previous measurements. The results indicate that further investigation of the application of the method to open channel turbulent flow is justified. (Betchart-Ill)
W69-05150

HYDRAULIC GEOMETRY OF ILLINOIS STREAMS,
Illinois State Water Survey, Urbana; Illinois Univ., Urbana.
John B. Stall, and Yu-Si Fok.
Illinois Water Resources Center, Research Report No 15, July 1968, ii + 47 p, 26 fig, 10 tab, 39 ref. OWRR Project B-005-ILL.

Descriptors: *Channel morphology, Depth, Discharge, Geomorphology, *Hydraulic properties, Hydraulics, *Hydrology, Illinois, Reaeration, Streamflow, Velocity, Watersheds (Basins), Width.
Identifiers: *Hydraulic geometry.

A consistent pattern has been evaluated in which the width, depth, and velocity of flow in a stream change along the course of the stream with a constant frequency of discharge. These channel characteristics are termed hydraulic geometry and constitute an interdependent system which is described by a series of graphs having simple form, or by equations. The data from 166 stream gaging stations in Illinois have been assembled and used to develop the parameters to define the hydraulic geometry of these streams. Results are presented as separate sets of equations for 18 river basins in Illinois. Stream characteristics are related to frequency of discharge and to drainage area as independent variables. Stream velocities computed from hydraulic geometry equations check favorably with actual stream velocities measured by time-of-travel in streams determined by using dye tracers. These equations are used to predict the average depth and velocity of flow at problem locations on the stream where no measurements are available. This allows computation of the reoxygenation capacity of the stream at the problem location, and will be valuable for many purposes in water resources development. (Betchart-Ill)
W69-05153

8C. Hydraulic Machinery

FLOW AND CAVITATION CHARACTERISTICS OF CONTROL VALVES,
Glenfield and Kennedy Ltd., Kilmarnock (Scotland).
E. Miller.
J Inst Water Eng, Vol 22, No 7, pp 512-533, Oct 1968. 22 p, 11 fig, 6 tab, 11 ref, 4 append.

Descriptors: *Cavitation, *Hydraulic valves, Hydraulic engineering, Hydraulic systems, Head loss, Fluid mechanics, Fluid flow, Pressure, Erosion, Foreign research, *Valves, Characteristics, Control, Losses, Mechanical engineering, *Flow characteristics, Experimental data, Noise, *Hydraulic gates and valves.
Identifiers: Great Britian, Scotland, Valve vibration, Cavitation index.

The flow control equation for a valve under steady-state conditions is developed in terms of valve and system characteristics. The effect of each of 4 independent factors influencing flow control is examined. For practical application, experimentally determined values of the head loss coefficient for various types of valves are given. A numerical example shows the adaptability of the flow control equation to tabular analysis. Cavitation in control valves is defined in terms of the cavitation number and a minimum pressure coefficient. The form of this coefficient is adaptable to tabular analysis. Experimentally determined minimum pressure coefficient values for various types of valves are given. The effect of each of the 3 independent factors contributing to the cavitation potential is examined. Since the minimum pressure coefficient is not easily measured directly, an indirect method is described. (USBR)
W69-04716

SEMI-SYNCHRONOUS STARTING,
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
J. F. Meyers, and T. F. Armbruster.
Allis-Chalmers Eng Rev, Vol 33, No 3, pp 4-7, 1968. 4 p, 3 fig.

Descriptors: Pumped storage, *Pump turbines, Hydroelectric power, Peak power, Electrical equipment, Electric potential, Investment, *Electric generators, *Hydroelectric plants, Voltage regulators, Costs, Electrical impedance, *Electric motors, Electric currents, Excitation.
Identifiers: *Starting, *Generator-motors, *Synchronous machines, Electric machinery.

Sizeable savings are being made by specifying a new starting method for large generator-motors in multiunit pumped storage plants. Generator-motors in the 200-300-mw range cannot be started in the usual across-the-line method. Semisynchronous starting offers an attractive alternate to the high cost of separate starting devices when across-the-line starting is not possible. This method is limited to a multiunit plant, either of all pumped storage units, or a combination of pumped storage and conventional hydrounits. With this starting method a generator-motor is started as a motor on its starting winding by connecting it to a generating unit operating at or near synchronous speed and at reduced voltage. Both units are isolated from the system. After the units have been synchronized at reduced frequency, they are accelerated to rated speed and synchronized with the system. Semisynchronous starting does not require a separate source of excitation for each unit because each unit uses its own exciter. This starting method is compared with different starting methods. (USBR)
W69-04722

INDEX METHOD FOR PUMPING OPERATION OF REVERSIBLE PUMP-TURBINE,
Hitachi Ltd., Hitachi City (Japan).
M. Yamabe, and Y. Yamaguchi.
Pap No 68-WA/FE-5, Amer Soc Mech Eng, Winter Annu Meet, Dec 1968. 5 p, 8 fig, 1 tab, 2 ref.

Descriptors: Hydraulic turbines, *Pump turbines, *Model tests, Francis turbines, *Flow rates, Discharges, Measurement, Laboratory tests, *Flow measurement, *Pumping, Foreign research, Mechanical engineering, Draft tubes, *Discharge measurement, Hydraulics.
Identifiers: *Differential pressure, *Winter-Kennedy Method, Foreign testing, *Reversible turbines, *Draft tube index method, Japan.

This paper describes the applicability of the Winter-Kennedy method and draft tube index method for measuring the hydraulic output of Francis and diagonal flow pump turbines under pumping operations. Experimental data obtained on 2 Francis pump turbines and one diagonal flow pump turbine are given. Data clarify that the Winter-Kennedy method of measuring flow rate is applicable to Francis pump turbines, but is not suitable to apply on diagonal flow pump turbines with adjustable guide vanes. The draft tube index method, depending upon differential pressure between 2 pressure taps provided on the draft tube or on the airpipe, indicates sufficient accuracy to apply to Francis and diagonal flow pump turbines. (USBR)
W69-04743

VELOCITY DISTRIBUTION AND ITS EFFECT ON THE ACCURACY OF THE GIBSON METHOD OF WATER MEASUREMENT,
Allis-Chalmers Mfg. Co., York, Pa.
G. Dugan Johnson.
Pap No 68-WA/FE-3, Amer Soc Mech Eng, Winter Annu Meet, Dec 1968. 5 p, 6 fig, 6 ref.

Descriptors: *Water measurement, Flow rates, Efficiencies, *Hydraulic turbines, *Gibson Method, Velocity distribution, Penstocks, Model tests, Closed conduits, Errors, Field tests, Analysis, Hydraulics, *Performance tests, Turbulent flow, Momentum, Discharge measurement, Models, *Flow measurement, Laboratory tests.
Identifiers: Recommendations, Friction coefficient (Hyd), Accuracy.

The Gibson method, used for many years in making efficiency tests on hydraulic turbines, applies only to measuring flow through pressure pipes or other closed conduits. The test is based on Newton's Second Law of Motion, which states that the rate of change of momentum of any body is equal to the force acting on that body. Significant basic errors are introduced into the Gibson method of measuring water flow rates, even in uniform straight pipes, by failure to consider velocity distribution in calculating results. Dr. Thoma's 1926 analysis of the method is quoted extensively, including his conclusion that long, straight lengths of pipe upstream and downstream from straight differential-diagram test sections would eliminate the effects of accessory motions, and his recommendations for establishing an experimental installation to determine the effects of various disturbed flow conditions. The need for correction factors or meter coefficients to avoid consistent errors of approximately 2% is emphasized. (USBR)
W69-04744

INVESTIGATION OF THE INTERNATIONAL PASSAMAQUODDY TIDAL PROJECT.
For primary bibliographic entry see Field 06B.
W69-05007

WATER REQUIREMENTS OF ELECTRIC UTILITY STEAM-ELECTRIC-GENERATING PLANTS IN 1959.

Report, Federal Power Commission, Bureau of Power, Washington, D. C., May, 1961.

Descriptors: *Electric power industry, *Electric powerplants, *Water requirements, Cooling water, Water utilization, Water supply, Industries, Engineering structures, Industrial plants, Powerplants, Structures, Water types, Efficiencies, Supply, Recirculated water, Steam.

This report summarizes water use by steam-electric generating plants in the United States (excluding Alaska and Hawaii) for the year 1959. The data are summarized by geographic area, fresh or brackish supply, recirculation, losses, and amount discharged.
W69-05063

WATER RESOURCES ACTIVITIES IN THE UNITED STATES: ELECTRIC POWER IN RELATION TO THE NATION'S WATER RESOURCES.
Report, Senate Select Committee on Water Resources, United States Senate, Washington, D. C., Committee Print No. 10, 1960.

Descriptors: *Electric power, *Cooling water, *Forecasting, Electricity, Water types.

An analysis is made of the determinants of electric-power production, by basic energy source, in the United States. Electric-power production is projected through 1980 by energy source and regions. Cooling water requirements for electricity production are also projected.
W69-05064

8D. Soil Mechanics

SHORING FOR THE SEATTLE FIRST NATIONAL BANK BUILDING, SEATTLE, WASHINGTON,
Shannon and Wilson, Seattle, Wash.
William L. Shannon, and Robert J. Strazer.
Pap, Shannon and Wilson, Inc, Soil Mech and Found Eng, Seattle, Wash, 1968. 12 p, 5 fig.

Descriptors: *Shoring, *Anchors, Cut slopes, *Cuts, Excavation, Safety factors, Foundations, Grouting, Shear strength, Soil properties, Piles (Foundations), Soil stability, Extensometers, Soil mechanics, Deflection, Construction.
Identifiers: Pull-out tests, Deflection measurement.

The 50-story Seattle First National Bank Building, the tallest structure in Seattle, Wash, rises above the deepest excavation ever made in Seattle for a single building. Vertical cuts on the 4 sides of the block-square excavation ranged from 35 to 78 ft high. An unobstructed construction area was provided by shoring with a system of soldier piles with tied-back earth anchors. The soil consisted of hard fractured clays, silts, and very dense silty sand with a considerable number of peaty zones. The soldier piles were placed in augered uncased holes extending 5 ft below the bottom of the excavation and were encased for this depth in high-strength concrete. The piles were 3 ft on centers and the area between was coated with 1 to 3 applications of a sprayed membrane to prevent surface drying, spalling, and soil erosion. The tiebacks were placed in 12- or 16-in.-dia holes augered from the excavation. In clay, several combinations of diameter and length of anchors were used, all based on developing an allowable shear strength of 0.5 ton/sq ft at the clay-anchor interface. Pullout tests were performed on 7 anchors. Each anchor was loaded in increments to failure or to twice the design load (192 kips). (USBR)
W69-04721

PARTICLE SIZE AS A BASIS FOR PREDICTING FROST ACTION IN SOILS,
National Research Council of Canada, Ottawa (Ontario).
For primary bibliographic entry see Field 02C.
W69-04739

EFFECT OF CONTINUOUS SURCHARGE ON A RETAINING WALL,
M. N. Vargin.
Soil Mech Found Eng, No 3, pp 160-164, May-June 1968. 5 p, 3 fig, 1 tab, 7 ref.

Descriptors: Soil mechanics, *Retaining walls, *Earth pressure, Earth movements, Saturated soils, *Live loads, Soil pressure, Dry condition, *Pressure distribution, Deflection, Vertical loads, Horizontal loads, Foundations, Pressure gages.
Identifiers: *Loading tests, Test results, Compressive stress, Coulomb Theory, Arch action, At rest pressure, Surcharge.

Studies were made to clarify the problem of pressures on a retaining wall, with dry and saturated backfill, with varying distances from the load to the wall and with deflection of the wall. The conclusions made from analysis of the tests are reported. Test curves differ from theoretical computed curves for submerged soil. Water has little effect on the shape of the pressure diagram. The increase in pressure caused by full uniform live load (surcharge) is 20-30% higher than the theoretical Coulomb value with allowance for wall friction. The effect of surcharge is not uniform for the height of the wall, but depends on the height of the fill. The angle of influence of the surcharge at a distance from the wall is less than the angle of response for dry and saturated fill. Surcharge behind the prism of rupture relieves pressure on the wall. Action of a full uniform surcharge on a wall decreases as the wall is shifted away from the fill; the pressure intensity drops mostly at the lower part of the wall, where pressure generally increases very slowly with increased surcharge. (USBR)
W69-04740

SOME ASPECTS OF DESIGN AND CONSTRUCTION OF EARTH AND ROCKFILL DAMS IN INDIA,
N. N. Yakovlev.
Water Resour J, pp 1-16, Sept 1968. 19 p, 9 fig, 5 tab.

Descriptors: *Earth dams, Dam design, *Rockfill dams, Riprap, Drainage systems, Cutoff trenches, Cutoffs, Slope stability, Permeability, Cores, Impervious materials, *Foreign design practices, Slope protection, Dams, Foreign construction, Internal friction, Seepage, Cohesion.
Identifiers: Earthquake zones, Construction methods, Seepage control, India.

Design and construction practices for earth and rockfill dams in India are illustrated by 15 example dams, some still under construction. Ten are earth, 2 are composite, and 3 are rockfill dams; heights vary from 15 to 225 m and embankment volumes from 2 to 32 million cu m. Ten dams are located in seismic intensity areas of VII to IX on the modified Mercalli Scale. Most of the dams have an impervious clay core with a coefficient of permeability of the order of 1 to 0.01 ft/yr. The core forms 40 to 70% of the dam's cross-sectional area. Depth of cutoff trenches ranges from 15 to 46% of the dam height and the bottom width ranges from 20 to 50% of the height. Most existing dams have a downstream horizontal filter blanket with a toe drain. Some of the more recent dams have a vertical or inclined filter running almost throughout the height of the dam. Many of the dams are subjected to annual reservoir drawdowns (up to 80% of the dam height). Hand-placed rock riprap is widely used in India for protecting the upstream slope against wave action and scour. Technical features of the dams are given in a table; cross sections of 9 dams are included. (USBR)
W69-04742

INSTRUMENT FOR MEASURING SOIL DEFORMATIONS IN DEPTH,
B. N. Mel'nikov, and V. B. Shvetsov.
Soil Mech Found Eng, No 1, pp 19-21, Jan-Feb 1968. 3 p, 3 fig, 10 ref.

Descriptors: *Instrumentation, *Measuring instruments, Soil mechanics, *Settlement, *Deformation, Embankments, Foreign research, Earth dams, Boreholes, Sensors, Ammeters, Potentiometers, Recording systems.
Identifiers: Deformation meters, *Borehole deformation gage, USSR, Foreign testing.

Soil deformation in depth can be measured with an instrument that does not have a permanent mechanical connection with the ground surface. The instrument consists of 3 basic parts: sensor, display unit, and markers. The sensor is a resonance circuit with all elements sealed in an airtight, 15-mm-dia capsule of dielectric material. The display unit is mounted in a metal housing on the face panel containing a microammeter, potentiometers, tumbler switches, and a manual control level. Markers are 60-mm-dia and 4-6-mm-high continuous rings containing thrust springs for firm attachment to the soil. To measure soil deformation, the sensor is lowered into a borehole along a guide tube of a dielectric material on a special measuring tape. When the sensor passes through a marker ring containing a short-circuit coil, a maximum change in current is recorded by the microammeter. Soil deformation at a given depth is then determined by relating to a fixed surface benchmark. The instrument may be used as a portable unit when measuring soil deformation in various boreholes. Measurement accuracy is 1 mm. The technique used to place markers is described. (USBR)
W69-04746

SOIL DENSITY MEASUREMENTS WITH GAMMA-RAYS,
University of Strathclyde, Glasgow (Scotland).
E. Pirie, K. Lin, and D. Taylor.
Soil Sci, Vol 106, No 6, pp 411-414, Dec 1968. 4 p, 4 fig, 1 tab, 6 ref.

Descriptors: *Nuclear meters, *Soil density, *Gamma rays, Attenuation, *Gages, Soil mechanics, *Measuring instruments, Detectors, Calibrations, Soil physical properties, *Soil density probes, Nuclear meters, Energy, Radiation.
Identifiers: *Nuclear density meters, Compton scattering, Nuclear radiation, Backscattering.

The use of a gamma-radiation backscatter gage to measure soil density was studied. When the energy of backscattered radiation falls below 0.5 Mev, a soil-type effect occurs. This effect is a shift of the counting rate versus the density characteristic according to the mean value of the atomic number. The soil-type effect is substantially reduced by restricting the scattering angle to less than 90 deg, instead of allowing scattering angles up to 180 deg as in the conventional instrument. The maximum counting rate is obtained at some specific density equal to 16 divided by d, the source-detector distance. This formula may be used in choosing the appropriate geometry to cover any specific range of densities. An instrument with a variable source-detector separation and an adjustment for maximum response could be calibrated to read the density as a function of the separation d, independent of the type of material being tested. A calibration curve would not be required and instrument performance would be largely independent of various instabilities. (USBR)
W69-04747

8E. Rock Mechanics and Geology

AN ENERGY CRITERION FOR THE STRENGTH OF ROCK IN POLYAXIAL COMPRESSION,
Chamber of Mines, Johannesburg (South Africa).
G. A. Wiebols, and N. G. W. Cook.
Int J Rock Mech Mining Sci, Vol 5, No 6, pp 529-549, Nov 1968. 21 p, 24 fig, 14 ref, 3 append.

Descriptors: *Rock mechanics, Rock properties, Stress analysis, *Shear strain, Shear strength, *Compressive strength, Strength of materials, Triaxial compression, Triaxial shear, Mohr circle, Biaxial compression, Biaxial stress, Unconfined compression, Cracks.
Identifiers: Stress energy, *Strain energy, Triaxial tests, *Sliding friction, Foreign testing, South Africa, Griffith theory.

Rock strength is generally accepted as being influenced by the presence of flaws, usually known as Griffith cracks. Various criteria of strength fail to describe adequately the strength of rock under a general system of polyaxial compressive stresses. In particular, no account is taken of intermediate stress. Various strength criteria usually attribute the onset of failure to cracks at a particular orientation. A new criterion is proposed for rock strength, based on the additional energy stored around Griffith cracks caused by the sliding of crack surfaces over each other. Strength predictions based on this concept agree with the acknowledged behavior of rock under uniaxial and triaxial stress systems. Under polyaxial compression, intermediate stress has a pronounced and predictable effect. Cracks over a wide range of orientations contribute to the failure process; the limits are determined solely by the coefficient of sliding friction between crack surfaces. Polyaxial compressive strength of a rock can be predicted from uniaxial strength and the coefficient of sliding friction between crack surfaces. (USBR)
W69-04711

STATIC AND KINEMATIC CONDITIONS OF THE STABILITY OF JOINTED AND FISSURED ROCKY FOUNDATIONS OF ARCH DAMS,
Ljubljana Univ. (Yugoslavia).
J. Drnovsek.
J Int Soc Rock Mech, Vol 6, No 3, pp 126-132, 1968. 7 p, 2 fig, 4 tab, 2 ref.

Descriptors: Damsites, *Dam foundations, *Arch dams, Foundation rocks, Fissures (Geology), Joints (Geology), Foundations, *Stability analysis, Kinetics, Rigid foundations, Sliding, Equilibrium, Moments, Foreign design practices, Stress analysis, *Rock foundations, *Rock mechanics, Three-dimensional.

Identifiers: Static behavior, Sliding block mechanism, Yugoslavia, Mratinje Dam (Yugoslavia), Rock interfaces, Sliding friction.

A 3-dimensional stability analysis is presented for jointed and fissured rock foundations of arch dams. Polyhedral slip blocks with sides following the main joints or fissures are treated as rigid static systems. All 6 equilibrium conditions are used to get reaction forces on the block boundaries; these are necessary for checking assumed displacements and possible distribution of reactive forces along main joints. The supernumerary unknown components of the reaction forces and the vectors of their application points are eliminated by appropriate assumptions according to kinematic conditions. The necessity for considering moment equilibrium conditions is proven. The method is interpreted by application to the analysis of the rock foundation of the 200-m-high Mratinje arch dam in the Piva Valley of Yugoslavia. (USBR)
W69-04713

THERMAL INFRARED IMAGERY FOR GEOLOGISTS,
Chevron Research Co., La Habra, Calif.
For primary bibliographic entry see Field 07B.
W69-04745

8F. Concrete

FATIGUE TESTS OF REINFORCING BARS--EFFECT OF DEFORMATION PATTERN,
Portland Cement Association, Skokie, Ill.
John M. Hanson, Kenneth T. Burton, and Eivind Hognestad.
J Portland Cem Ass, Vol 10, No 3, pp 2-13, Sept 1968. 12 p, 9 fig, 2 tab, 29 ref.

Descriptors: *Reinforcing steel, *Reinforced concrete, Deformation, Fatigue (Mechanics), *Deformed bars, Concrete technology, Strength of materials, Concrete testing, Laboratory tests, Beams (Structural), Structural design, Bibliographies.
Identifiers: *Fatigue tests.

Results of fatigue tests are reported on concrete beams reinforced with No. 8 American- and European-made reinforcing bars. The American-made bars had cresent-shaped transverse lugs that did not merge into the longitudinal ribs. The European-made bars had inclined transverse lugs that did not merge into helical longitudinal ribs. Test results indicate that orientation of longitudinal ribs has little effect on the fatigue strength of reinforcing bars. The fatigue strengths are comparable to those of several different types of American-made bars with transverse lugs that merge into the longitudinal ribs. Geometry at the base of the lug has a significant influence on the fatigue strength. (USBR)
W69-04706

A REVIEW OF FIBER REINFORCEMENT OF PORTLAND CEMENT PASTE, MORTAR, AND CONCRETE,
Portland Cement Association, Skokie, Ill.
G. E. Monfore.
J Portland Cem Ass, Vol 10, No 3, pp 43-49, Sept 1968. 7 p, 7 fig, 7 tab, 12 ref.

Descriptors: *Reinforced concrete, Reinforcement, Reinforcing, Mortar, Reinforcing steel, Plastics, *Glass fibers, Portland cements, *Fibers, Concrete technology, Asbestos cement, *Composite materials, Materials engineering, Nylon.
Identifiers: Concrete products, Cement paste, *Reinforcing materials.

The development of fiber-reinforced portland cement paste, mortar, and concrete is reviewed. Reinforcing fibers under investigation include asbestos, glass, plastics, and steel. Asbestos fibers have been successfully combined with portland cement paste to form asbestos-cement products. The possibility of increasing the efficiency of asbestos fiber reinforcement by increasing the extensibility of portland cement paste appears remote. Glass fibers are under investigation in the development of a glass-fiber portland cement product comparable to asbestos-cement. Plastic fibers may be useful as energy absorbers in concrete subject to explosive loading. Because of the cost, using steel fibers in concrete will probably be limited to special applications where conventional reinforcement is not satisfactory. (USBR)
W69-04708

THE EFFECT OF MIX PROPORTIONS AND AGGREGATE DUST UPON THE COMPRESSIVE STRENGTH OF CONCRETE,
Birmingham Univ. (England).
B. P. Hughes, and J. E. Ash.
Mag Concr Res, Vol 20, No 63, pp 77-84, June 1968. 8 p, 7 fig, 3 tab, 6 ref.

Descriptors: *Concrete mixes, Concretes, *Concrete technology, *Fines, Concrete testing, Aggregates, *Fine aggregates, Shrinkage, *Compressive strength, Sands, Dusts, Water-cement ratio, Foreign research.
Identifiers: Concrete properties, *Aggregate cement ratio, *Cement content, Cement paste, Water content, Foreign testing, Great Britain.

The compressive strength of concrete at a constant cement-water ratio decreases with increasing cement content. The strength decrease is generally quite small, especially for uniaxial compressive strength. Two exceptions are possible, depending on sand content: (1) at high sand contents, a critical maximum sand-cement ratio is exceeded so that air voids become unavoidable and the strength decreases with decreasing cement content; and (2) at low sand contents, a critical minimum sand-cement ratio is not attained and large strength losses occur with increasing cement contents. A critical minimum sand-cement ratio exists because of extensive water gain and lack of adequate shrinkage restraint of the cement paste; the value depends upon the type and grading of the aggregate and mix proportions. These effects should be avoided in normal concrete. Dust in fine aggregates can be beneficial for low-strength concrete because of modifications of the cement past structure and reduction of water gain, but has little effect on high-strength concrete. (USBR)
W69-04715

A STUDY OF DEPASSIVATION OF STEEL IN CONCRETE,
Bureau of Reclamation, Denver, Colo.
L. O. Timblin, and T. E. Backstrom.
Pap, 25th Annu Meet Nat Ass Corros Eng, Houston, Tex, Mar 1969. 39 p, 7 fig, 1 tab, 14 ref.

Descriptors: *Corrosion, *Corrosion control, Concrete technology, Reinforced concrete, Prestressed concrete, Thin films, Electrolytes, *Chlorides, Slurries, Cements, Alkalinity, Solutions, Sulfates, Steel, Interfaces, *Reinforcing steel.
Identifiers: Concrete properties, Ion concentration, Corrosion tests, Activation, *Passivity, Corrosion inhibitors, Electrochemical corrosion.

Corrosion of steel embedded in concrete occurs when the passivating conditions normally protecting embedded steel are changed sufficiently to permit activation of the steel. One factor greatly influencing the activation process is the chloride ion. This study was made on the mechanism of passivation and depassivation of steel in a simulated concrete environment under the controlling influence of the chloride ion. Tests were performed to determine whether (1) passivated steel tends to maintain passivity when exposed to a nonpassivating environment, (2) chloride ions tend to accelerate depassivation of steel, or (3) film formation is retarded by the presence of chloride. Results indicated that: (1) depassivation of steel occurs quickly after removal of the passivating environment; (2) chloride accelerates film breakdown in the case of a passivated specimen and aids in establishing active corrosion cells in unpassivated specimens; and (3) the presence of 0.08M chloride in normally passivating solutions of saturated calcium hydroxide is sufficient to prevent passivation of steel, and corrosion can occur (subject to local conditions) at chloride concentration as low as 0.02M. (USBR)
W69-04725

STRENGTH OF JOINTS AND JOINT ASSEMBLIES OF REINFORCED CONCRETE MULTISTORY FRAMES UNDER LOADS OF THE SEISMIC TYPE,
S. P. Vasil'ev, Iu D. Bychenkov, and Iu E. Tiablikov.
Transl from Russ, Bur Reclam Transl 683, Feb 1969. 17 p, 6 fig, 2 tab, 1 ref. Beton I Zhelezbeton No 8, pp 2-7, 1968.

Descriptors: Joint fillers, *Reinforced concrete, *Continuous frames, *Joints, Buildings, Continuous structures, Compression, *Seismic design, Columns, Reinforcing steel, Seismic studies, Welding, Shear tests, Shear, Foreign design practices, Laboratory tests, Eccentric loading, Strength, Stress, Shear failures.
Identifiers: *Dynamic loads, *Multistory buildings, Destructive tests, USSR, *Cyclic loads, Earthquake loads, Seismic stability.

The USSR Scientific-Research Institute for Reinforced Concrete investigated the seismic strength of several types of joint assemblies with continuous joints between precast columns and cross beams under cyclic loads with P min/P max = 0.1. Specially constructed test joint assemblies, consisting of stub columns and cantilevered beams with welded reinforcement (with and without brackets), were tested to failure under eccentric compression and compression with shearing force. Some types had ferrocement centerplates, some had steel centering pipes, and some had no centering component. Tables give full data on tests and nature of failure. Monolithized column joints (joints grouted with mortar and exposed ends of reinforcement welded) for multistory buildings have adequate strength and are recommended for seismic areas, but they must be located away from the contact edge of the joint assembly to reduce bending moments. The tested joint-assembly designs, except Series IV, can be used for multistory buildings, but in seismic areas semiautomatic welding of reinforcement in copper and graphite forms is generally recommended, although several hand welding processes may be used under special conditions. (USBR)
W69-04735

8G. Materials

POLYAMIDE-IMIDE INSULATION VARNISH,
Sumitomo Electric Industries Ltd., Osaka, (Japan).
Shigeru Matsumura, Nobuyuki Asano, and Masahiro Izumi.
Sumitomo Elec Tech Rev, No 11, pp 43-48, Oct 1968. 6 p, 14 fig, 2 tab.

Descriptors: *Electric insulation, *Varnishes, Coatings, Impregnation, Solvents, Viscosity, Resins, Films, Electrical properties, Electrical equipment, Heat resistance, Electrical resistance, Tensile strength, Flexural strength.
Identifiers: *Electrical insulation tests, Shelf life, Test results, Japan, Foreign products, Electric machinery, Bond strength.

Properties of a new electrical insulating varnish are described. This newly developed polyamide-imide varnish for coil impregnation is better than Class H varnish for electrical machinery and apparatus. Test results of general properties of the varnish, baking conditions, storage stability or shelf life, bond and tensile strength, flexural strength, and electrical characteristics are compared with other types of varnishes such as polyimide, silicone, and diphenyl oxide. This varnish will produce films 0.035-mm thick with one application and baking, is

heat-resistant, and has well-balanced properties. (USBR)
W69-04719

8I. Fisheries Engineering

OBSTRUCTING AND PREVENTING FISH FROM RUNNING UP RIVERS OR CREEKS; POISONING STREAM OR USING EXPLOSIVES TO CATCH FISH.
For primary bibliographic entry see Field 06E
W69-04871

09. MANPOWER, GRANTS AND FACILITIES

9D. Grants, Contracts, and Research Act Allotments

FEDERAL ASSISTANCE IN OUTDOOR RECREATION.

Journal of Soil and Water Conservation, Vol 18, No 2, March/April, 1963, pp 57-60.

Descriptors: *Recreation, *Government supports, *Land management, *Cost sharing, *Credit, Federal government, Recreation, Governments, Recreation demand, Management.

Credit, cost sharing, technical, educational, or research help in outdoor recreation is offered to states and their political subdivisions to organizations, and to individuals by a number of federal agencies. Summaries of the various assistance programs available are given in this article.
W69-04989

ANNUAL REPORT, FISCAL YEAR 1968,
Ohio State Univ., Columbus. Water Resources Center.
G. P. Hanna, Jr.
Annual Report to Office of Water Resources Research, September 1, 1968. 118 p.

Descriptors: *Ohio, *Programs, Acid mine water, Great Lakes, *Lake Erie, Eutrophication, Ground water, Hydrology, Small watersheds, Water quality, Algae, Phosphates, Economics, Recreation demand, Taxes, Appalachia.

Eight current allotment projects and seven matching grants projects are described. A strong orientation of the Center's activities toward the problems of water quality in Lake Erie is evidenced by these projects. Four biological projects were designed to fill critical gaps in the available knowledge pertaining to chemical, physical and biological phenomena in Western Lake Erie and its tributary streams. Two projects involving the economics of the area also provides the broadening of our involvement in the Lake Erie basin. Two projects, associated with the Center's earlier emphasis on acid mine drainage, remain. Three hydrological projects are also included; one dealing with characteristics of small watersheds, the other two relating to ground-water flows. Completion of a study on strontium isotope and trace-element concentrations in Lake Huron is also reported. A sociological study is also underway to examine community reactions to water problems in relation to planning.
W69-05160

10. SCIENTIFIC AND TECHNICAL INFORMATION

FLUID DYNAMICS,
Clarkson Coll. of Technology, Potsdam, N. Y.; Rensselaer Polytechnic Inst., Troy, N. Y.
For primary bibliographic entry see Field 08B.
W69-04701

EVAPOTRANSPIRATION-REVIEW OF RESEARCH,
Nebraska Univ., Lincoln. Dept. of Horticulture and Forestry.
For primary bibliographic entry see Field 02D.
W69-04764

ALGAL GROWTH AQUEOUS FACTORS OTHER THAN NITROGEN AND PHOSPHORUS,
Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio.
For primary bibliographic entry see Field 05C.
W69-04801

NITROGEN AND PHOSPHORUS IN WATER; AN ANNOTATED BIBLIOGRAPHY OF THEIR BIOLOGICAL EFFECTS.
Public Health Service, Washington, D. C.
For primary bibliographic entry see Field 05C.
W69-04805

THERMAL DISCHARGE BIBLIOGRAPHY,
State Univ. of New York, Albany. Atmospheric Sciences Research Center.
For primary bibliographic entry see Field 05B.
W69-04937

DOCUMENTATION: INFORMATION AND INSTRUCTION CONCERNING THE PROBLEMS OF WATER,
Centre Francais d'Information de l'Eau.
R. Colas.
For the 8 Volume Proceedings, see Vol 2, No 9, Field 06B and W69-03305. Int Conf on Water for Peace, Wash, D C, Vol 4, pp 458-461, 1967. 4 p.

Descriptors: *Documentation, *Data storage and retrieval, *Information retrieval, Publications, Classification, Automation, Technical writing, Bibliographies, Translations, International commissions.
Identifiers: *Indexing data, France, Centre Francais d'Information de l'Eau.

In spite of the large amount of published material on water already gathered and currently being published at an accelerating rate, its very usefulness will be impaired unless the organization and methods of use are revised or changed. In France, a permanent office has been created for the study of the problems of water and in 1959, an organization was established, the 'Centre Francais d'Information de l'Eau' (CEFIE). This organization has concluded that as soon as possible an automatic system should be applied to documentation and that for this purpose the system of key words is indispensable for the indexing, classification, and utilization of documents. Consequently the 'thesaurus' method has been tried out in France and will be ready for use by the middle of 1967. An international organization is suggested having the mission of classifying the abundant documentation on all aspects of water; this might bring some order in storage and retrieval of current pertinent information on water and help avoid prejudicial confusion in the development of the science and technology of water. (Vorhis-USGS)
W69-04940

A BIBLIOGRAPHY ON PERIPHYTON,
Federal Water Pollution Control Administration, Cincinnati, Ohio. Div. of Pollution Surveillance.
Cornelius I. Weber.
(Processed Document) Div Pollution Surveillance, Federal Water Pollution Control Admin, Washington, D.C. 246 ref.

Descriptors: *Bibliographies, *Periphyton, Benthos, Estuaries, Lakes, Ecology, Ecosystems, Microbiology, Microorganisms, Rivers, Streams.

This bibliography includes 246 citations of reports published between 1902 and 1966. of which 112 appeared during the period 1960–1966. The list contains all references in the compiler's file which deal directly with microflora, microfauna, and fungi that are found attached to natural or artificial substrates or are associated with these attached communities in lakes, streams, and estuarine habitats. Author states that list may be incomplete, and he desires to be made aware of omissions. (Eichhorn-Wisconsin)
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(9) Illinois State Water Survey	W69-05159	1
(10) Ohio State University - Water Resources Center	W69-05160	1
(11) Purdue University - Water Resources Research Center	W69-05143	1
	Grand Total	474

Subject Fields

1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

5 WATER QUALITY MANAGEMENT AND PROTECTION

6 WATER RESOURCES PLANNING

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